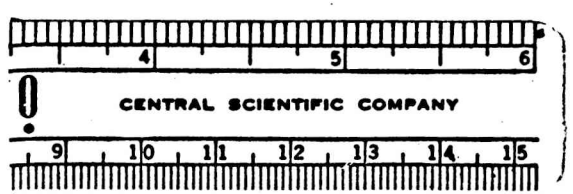
RACES . . . *a Study of the Problems of Race Formation in Man*



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A Monograph in

AMERICAN LECTURES IN PHYSICAL ANTHROPOLOGY

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RACES . . . *A Study of the Problems of Race Formation in Man*

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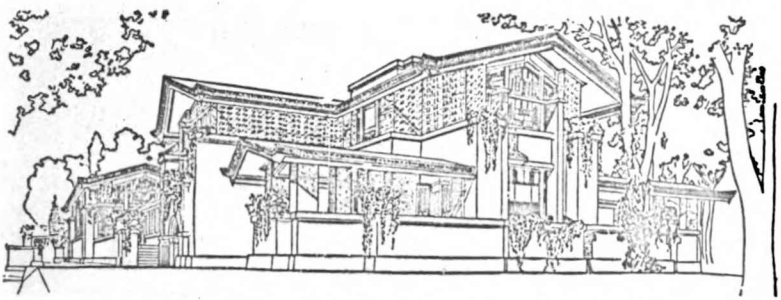

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Editorial Preface

THE growth of the science of physical anthropology in recent years has been both rapid and diversified, with the inevitable result that no one person is qualified to write authoritatively about the whole field. Largely for this reason no single book exists in the English language which can claim to deal comprehensively with all phases of the modern science. Yet there can be no doubt that an acute need prevails for up-to-date, expert discussions of its main facts and most important conclusions. A series of small publications by leading authorities would seem to be the answer to this problem. Such is the purpose of the *American Lectures in Physical Anthropology.*

In organizing these *Lectures* the editors originally planned to have specialists write about clear-cut subdivisions of the field in a consistent fashion, concentrating on established facts. These specifications, it soon appeared, placed too heavy a restriction upon the authors' originality. Hence, these *Lectures,* instead of forming chapters of what eventually would have become the equivalent of a conventional textbook, will present discussions by authorities of subjects in which they are intensely interested. Each author will be free to treat his topic as he sees fit, supporting his interpretations by selected facts, and not necessarily attempting exhaustive coverage. Because subjects in physical anthropology usually are interrelated, *Lectures* by different authors will probably overlap somewhat and may show theoretical contradictions.

The first *Lecture* is largely the product of Dr. Coon, the author of the well-known, scholarly work *The Races of Europe.* When Dr. Coon agreed to write on Human

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Races he had in mind, fortunately, a somewhat different and more exciting presentation than the editors had anticipated. Indeed, the manuscript submitted by Dr. Coon and his collaborators Drs. Birdsell and Garn, was responsible in no small measure for the revision in the editorial plans mentioned above.

The editors feel confident that readers will find the first *Lecture* readable and stimulating. Also, they hope soon to add to this series other contributions of equal value and originality. Specialists are now preparing manuscripts on human genetics, ancient man, and human growth. Other subjects to be represented include human constitution, anthropometry, history of physical anthropology, and primates. The editors are not hurrying the authors, nor are they being concerned about the order in which these *Lectures* will appear. They have become convinced, as Mr. Thomas the publisher has been for some time, that it is best to select a writer who has something to report and then to let him state it in his own manner and in due time.

The editors have been greatly encouraged by the far-sighted publishing policy of Mr. Thomas, which has made possible the initiation of these anthropological *Lectures*. His intention of bringing out revised editions as demanded by the accumulation of new data and ideas promises a healthy future for the series. Finally, the editors wish to take this opportunity to record their gratitude to the Viking Fund Inc., of New York City, for its generous aid to the authors of the present volume in the preparation of illustrations.

T. D. Stewart
A. H. Schultz
W. W. Howells

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Introduction

IF a research scientist is lucky, he is also a teacher. Every now and then he has to work up a new course, or rework an old one. A course covers the totality of some field of knowledge, and that field must be dealt with as a unit. The teacher soon finds that more is known about some branches of the field than about others. Despite the unevenness of the material he has to create a scheme which covers all. Part of the scheme is based on known and proven evidence, part of it on pure speculation, of "hunches"; ideas which seem logical at the time because of the directional indications of peripheral material. Still another part, and this may be the largest of all, falls into a twilight zone of imperfectly documented evidence the direction of which is nevertheless reasonably clear.

What is he to do? He can tell the students: "This much is cut and dried. Ignore the rest." This virtuous approach leaves the students nearly as ignorant as before, and more confused. A fragment of something has been described to them out of context. If the scientist is uncritical or unscrupulous, he can erect his scheme on a combination of sound evidence, poor evidence, and no evidence at all, and present it as a whole without discrimination. This type of teaching leads students astray.

A third or middle way is to take the evidence as a whole, erect the best scheme possible, and present it to the students as a tentative structure, with alternatives; while documenting the evidence critically. The instructor who follows this scheme can say: "This statement is based on experimental evidence and seems perfectly sound; this next one is probably true, but the evidence needs more testing before we can be sure; and this last is my own theory,

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pure and simple, (or someone else's), and I hope that one of you (or someone else) will test it to see whether or not it is true."

By following the third course the scientist can give full scope to his creative imagination and stimulate, rather than inhibit, its development in others. At the same time he can teach the sound evaluation of evidence and turn out well-rounded thinkers who are not afraid to handle concepts as wholes.

The field of knowledge which a scientist selects for his course need not fall into the confines of any one -ology; if it is to be really useful it usually crosses a number of arbitrary borders, for most academic categories are based on techniques of study rather than on problems to be solved. Nature is a whole, and no matter how we divide it up for convenience into disciplines, traces of the connections still remain, and we cannot be sure how any one part works until we have followed these connections down to their source.

The present *Lecture* comprises a field of knowledge—racial variations in man. In order to understand them we have to know something about many disciplines: physical anthropology, comparative anatomy and physiology, biology (especially genetics), paleontology, cultural anthropology, archeology, history, and even radiation and pathology.

The present authors (and 30 would have been more appropriate than three) are limited by two horizons: the paucity of pertinent knowledge in many of the contributing disciplines, and their ability, in time and energy, to find and use what is already known and published. We are sure that if we had five more years and nothing else to do, we could document this lecture well enough to test all of our theories, and perhaps create others. All we can

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do at present is to follow the middle course as stated above. The editors, quite naturally, are unhappy about the paucity of references. Also, they have asked us to call attention here to the fact that we have employed the principles of natural selection following mutation more strongly than other systems.

This is a truly composite work. Not only has it three authors, but also it has, at various stages, passed the scrutiny of many experts in fields peripheral to physical anthropology but pertinent to the present investigation. These include Dr. H. L. Movius, Dr. Gordon T. Bowles, Prof. W. J. Crozier, Prof. Th. J. Dobzhansky, Prof. S. L. Washburn, Prof. W. C. Boyd, Dr. J. N. Spuhler, Dr. Thomas Gladwin, Dr. H. E. Landsberg, Prof. R. W. Ehrich, Dr. George C. Shattuck, Dr. Menard Gertler, Dr. Percy Howe, Dr. W. S. Laughlin, as well as the editors of this series who have given us the benefit of their kindness and wisdom. Theirs is the credit for much of what may be useful in this *Lecture;* ours is the blame for what may be wrong.

Except for the drawings, which were all made by one studio, credit for the illustrations is given with each plate and figure. The drawings were made by Robert Ullrich, Medical Arts Studio, 1101 Beacon Street, Brookline, Mass. The map was drawn by Mrs. Lisa D. Coon. We were able to have these drawings made only because the editors obtained a grant for the purpose from the Viking Fund, Inc., of New York City.

We are indebted for our photographs to the following 16 individuals: Dr. Gordon T. Bowles, Prof. E. E. Evans-Pritchard, Mr. Reuben Goldberg, Mr. Roland Hayes, Dr. A. C. Henriques, Mr. Michael Huxley, Dr. W. W. Krauss, Dr. Helge Larsen, Prof. David Mandelbaum, Lt. Gen. Sir Philip Neame, V.C., K.B.E., C.B., D.S.O., Prof.

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Georg Neumann, Mr. Charles Shade, Mr. Julian Steele, Dr. T. Dale Stewart, Miss A. J. Stout, and Mrs. Paul (Marion Lambert) Vanderbilt. For permission to publish the illustrations used in this volume we also must acknowledge our gratitude to the following 12 institutions: Alfred Knopf & Co., New York; The American Museum of Natural History, New York; The Clarendon Press, Oxford; The Geographical Magazine, London; The Institute for Northern Peoples, Leningrad, USSR; LIFE Magazine, New York; Karakashian Brothers, Tropical Photo Stores, Khartoum; The Macmillan Company, New York; Nationalmuseet, Copenhagen; The Peabody Museum, Harvard University, Cambridge, Massachusetts; the U. S. National Museum; and the University Museum, University of Pennsylvania, Philadelphia.

Many of the photographs owe their quality to having been copied by Mr. Reuben Goldberg, Staff Photographer of the University Museum, Philadelphia. In certain cases, air-brush work was needed to shade out background, and that was done by the studio of Mr. Thom Street of Philadelphia. Miss Barbara Copp, Custodian of Photographs at the University Museum, discovered many of the best pictures for us in her files.

C.S.C.
S.M.G.
J.B.B.

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Chapter 1

The Study of Races

THE MEANING OF "RACE"

AMONG professional anthropologists, as well as the public, there is confusion at present about the meaning of the word *race* as applied to man. The biologists, however, who study insects, plants, and other kinds of organisms, about which there is no reason for emotional controversy, are not confused. To them a race is a collection (basically a group) of individuals of both sexes, definitely associated with a place or region, habitually interbreeding, and possessing an historical continuity in the reproduction of a general type; these individuals tend not only to look alike but also to behave alike.

The different races of fruit fly (*Drosophila Pseudoobscura*) which Dobzhansky[20] has been studying will serve as an example. He finds that the differences between these races which are due to variations in chromosome structure appear to include not only the physical differences on which the racial classification is based, but also differences in habit, or more specifically, in breeding time. Some natural variants multiply in the months of April and May in the California mountains; others, in the same mountains, wait for July and August to do their breeding. Genetic differences, therefore, affect more than shape and size.

Race exists in the vegetable kingdom as well. Plants differ in their color, productivity, height and sturdiness because of their genetic make-up (other factors being equal). These genetic differences may affect the size of the fruit or its color or odor. The growing season, too, is

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an inheritable characteristic which distinguishes one breed of plant from another. Mangelsdorf describes one unique race of maize which has short cobs and a growing season of only 75 days, and another race distinguished by long cobs and a 150-day growing season.[58] In plants as among animals, the concept of race includes differences in observable, external characters, in behavior, in growth time, and in other variables, all genetically controlled. These variations serve, in the long run, to suit races to different environments, or to different phases of a single environment.

The same thing is true of man. Up around the Arctic Circle we find uniformly short peoples, and in the areas of greatest heat and sunlight the native peoples tend to dark skin and eye colors. A Yahgan Indian can go fishing in his canoe in chilly Antarctic waters for hours at a time with no clothing but a single sealskin on his back, and no other heat than a smoldering fire in the clay hearth amidships. An urban New Yorker would probably catch pneumonia were he to try to follow the Fuegian's example. Measles, which is typically only a childhood nuisance to white men, killed off thousands of Polynesians and American Indians when first introduced. A bony-faced Arab would probably freeze off his nose were he to spend a day outdoors hunting at −60° F. at Verkhoyansk, Siberia; a flat-faced Tungus, whose ancestors have lived in this environment for many generations, is able to stand this extreme of temperature.

Human beings differ in their physiological reactions to their different environments and consequently differ in appearance as much as do the members of any other animal species. Furthermore, individuals who resemble each other in most observable characteristics tend to be grouped together geographically. We can speak of races in man with as much assurance as if we were describing any other species.

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MEASURING PEOPLE

For nearly two hundred years anthropologists and others have been making classifications of human races. Some of the earlier scholars devised geographical systems, while others relied on skin color. Hair form came into vogue about the middle of the Nineteenth Century, and later on the cephalic index (length-breadth index of the head) was considered the really vital criterion. The practice of studying *all* of the more obvious, visible differences is quite modern. Early travelers made descriptions from memory, later investigators measured exposed parts of the body, particularly the head and face, while modern anthropologists more and more are able to strip their victims and study them from head to toe. A few have been able to make physiological tests.*

Whatever our special methods, we have all concentrated on the measurement of criteria which promised to yield the answers to special problems. In so doing many of us have forgotten that the method of science is to start at the beginning, however obvious it may seem, and to study the simplest and most basic properties of the subject, in this case, man. Physicists, who deal with a much more general field, have found that they can learn most about the properties of any bodies (defined as *substances possessing form)* by measuring, for each one, its principal diameters, its weight, its volume, and its surface area.

We have all measured *diameters,* including stature, limb lengths, the dimensions of the head and face, etc. Very few physical anthropologists, however, have measured *weight* in field studies, because scales were cumbersome and heavy.† Only a few scientists, notably J. B. Hamilton

* For an extensive historical survey of racial classifications, the student is advised to read Count (in press).[38]

† Morris Steggerda's development of light-weight beam scales promises to remedy this situation.

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in his study of eunuchs,[32] and Ancel Keys in his vascular research,[50, 51] have measured *volume* and its ratio to weight (specific gravity) by the ancient method of immersing their subjects in water. This technique has hazards for the field worker.

So far no one seems to have produced a method for measuring *skin-surface area* which answers our purpose. The surface-area tables used in computing the metabolic rate give average approximations estimated from height and weight. These correction factors correct for and thus obscure the very differences which we are trying to discover.

If we had these four measurements, stature (the principal length diameter), weight, volume, and surface area for persons of different races, they would provide a body of simple and significant mathematical constants by means of which we could go a long way in establishing the relationships between variations in human physiques and differences in terrestrial environments.

Instead of this, physical anthropologists possess a vast literature consisting mainly of constants for a number of special diameters of parts of the body, such as span, shoulder breadth, chest breadth and depth, sitting height, pelvic breadth, and the lengths and breadths of the extremities and many diameters of the head and face. We also make subjective observations of certain criteria, such as skin, hair, and eye color; hair form, the shape of the nose, the slope of the forehead, etc. For some series we also have photographs, in a few cases of the entire body,* in most others, of the head and face only.

We have a multitude of measurements on dry bones,

* Sheldon,[74] Hooton,[39] and others are classifying human beings into "somatotypes" on the basis of their observations of standard photographs in combination with a number of measurements. This subject will be dealt with in another *Lecture* of this series.

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for skeletal material is abundant and easier to handle than the living; it cannot refuse or talk back. Hundreds of investigators have studied aspects of racial differences in muscles and viscera revealed by dissection,[44,55] but their results have never been thoroughly summarized. A few others have tackled the biochemistry of racial differences, as revealed in pigment studies, and the optical analysis of color variations. Racial physiology is in the same situation. A useful body of this material is scattered through the medical journals awaiting collection and synthesis.

PHYSIOLOGY AND BEHAVIOR

Physiology lies at the base of behavior. Human beings are differentiated from other animals not so much in size, or shape, or color, or in the way their digestive tracts and vascular systems work, as in their *behavior*. Since the way in which people act is the crowning achievement of their rise to the human condition, one might suppose that students of human behavior would have been interested in relating varieties of behavior to anatomical, physiological, and genetic variations in man. As a matter of fact, very few of the findings of the social scientists lend themselves to scientific treatment with the precision which may be accorded the physical aspects of race. A notable exception is the interaction rate research of Chapple and his associates which has already yielded an objective measure of human personality.[13] Sheldon, Hooton, and others are trying to show the relationship between body types as defined by themselves and such psycho-physiological phenomena as disease predilection and types of personality as classified by the psychologists. Despite improvements of technique, both the anatomical and the psychological categories which they use are still largely subjective.

Thus we know a little about the size, shape, and density

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of our subject, the human organism; probably more than we need about the dimensions of some segments of its surface; a little about its chemical properties, although almost nothing about their variations; and variations in physiology and behavior are still largely unknown.

The variations in which we are interested move on two scales, space and time. On the scale of space it is possible to obtain all of the classes of information which we need if we can develop the techniques to measure them, train research workers to go out, and persuade governments suspicious of scientists to let them pass. On the scale of time we are limited to those parts of the human organism which survive decay. Usually all that we have is bones, which yield comparative data on many variations of size and form, and often of blood groups as well,[11] but which tell us nothing about the color and texture of the skin, the hair, the eyes, or the tip of the nose. If we are lucky, we may find evidence of these in painting and sculpture.

THE INTERPRETATION OF STATISTICAL DATA

These materials, obtained by the techniques of measurement and observation, are analyzed by physical anthropologists according to the usual statistical formulae. The object of scholars in so doing is to prove whether or not measured and observed differences between samples of populations are due to chance, or really reveal meaningful variations. Such proved variations mean: (a) that the populations concerned differ genetically; (b) that genetically similar organisms have been significantly altered by different environments; or (c) that both genetic and environmental differences are present. How are we to know what is genetic, and what environmental?

The argument between environmentalists and heredi-

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tarians has gone on for decades, but it need not go on forever. We are all the product of both heredity and environment. The genes provide the blueprints and the carpenters, the environment the lumber. Our capacity for learning is genetically controlled, our sense organs are portions of anatomy operated physiologically, and genes control these as well. How this whole process works can only be learned by patient accumulation of factual knowledge, intelligently interpreted. There is no short-cut to wisdom.

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Chapter 2

Race and the Genes

THE NATURE OF GENES

EACH human being is said to be the product of between 10,000 and 80,000 genes. Although it will be some time before an exact figure can be given, Spuhler's recent estimate of 44,000 pairs of genes for the 48 chromosomes seems reasonable and can be used as a working hypothesis.[77] A gene is not a miniature ear-lobe, kidney, etc., ready to grow under the proper stimuli into the adult form of that particular organ. It is probably a complex protein molecule or polypeptid or a cluster of the same, which provides the organism with a specific capacity for performance.

This principle can be illustrated through the study of the gene for albinism,[5] or, as some prefer, the absence of a gene which produces the normal pigmented condition. The normal human being supposedly possesses a specific gene which makes it possible to convert tyrosine into melanin, the substance of which most mammalian pigment is composed. If you have that gene, you can develop the amount of pigment in skin, hair, and eyes that the rest of your genes concerned with the color of these tissues permits them to have. If you have a different gene in place of this special gene, then you are an albino, whether you would otherwise have been a normal Negro, Mongoloid, or blond or brunet European.

The capacity for performance which a gene provides may or may not be realized, and if so in varying degrees. The forces that limit the expression of this capacity are

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derived from the external environment, either directly or through the agency of other genes. This may best be illustrated through the growth of the whole organism. Rats fed on diets rich in amino acids grow much larger than those fed on flour, and children brought up on diets rich in meat grow larger than their grain-fed parents, as many studies have shown. Growth is a complex business, and from its study we know that many of the genes involved control shape and proportions rather than actual size. However, in the largest of pituitary giants, the teeth do not grow after eruption. Some genes are more accommodating to environmental stimuli than others. The genetic composition of an organism is called the *genotype*, while the visible form which the adult of either sex assumes is called its *phenotype*. These words are properly applied to individuals, but for our purposes can be extended to populations, and can be used to designate the visible and invisible, or actual and potential, forms of races in our sense.

GENOTYPES IN MAN

Of the 44,000 genes attributed to man perhaps 90 per cent (39,600)* are held in common by all races of men. Were they not, some of us might have temperatures of others a normal temperature of 16 °. Of the remaining 4,000 or 5,000 postulated genes not held in common, we may again allow at least half for racial variations in physiology, growth rate, adult body form, degree of sexual dimorphism (differences between male and female), and other features which ordinarily escape the eyes and the calipers of the student of race.

According to the system which we are using, only 3 to 5 per cent of the whole man remains, or very tentatively

* In 1940, Ashley Montagu estimated at least 99 per cent.[a]

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about 2500 genes. Basing our further estimates on analogies with laboratory animals and counts of hereditary diseases and anomalies,* we may postulate about 100 genes affecting the teeth, 100 for hair variations, and perhaps 60 for pigmentation in all parts of the body. Tentative in the extreme as this set of estimates is, it is still definite enough in general to show that all of the characters which we consider racial, when added together, make up but a small part of the total man. Human beings have far more genes in common than they have apart.

However, if two men born in different countries have a specific feature in common, that does not necessarily mean that they have inherited the genes which control it from a remote common ancestor. For example, the two men may have curly hair. We know that in rabbits, at least 100 genes control hair form, and at least two of these independently produce curl. These genes are called Curly #1 and Curly #2. In man, blood group A (we will explain more about blood groups presently) has been broken down into A_1, A_2, A_3, etc. Each variant is produced by a separate gene, which apparently arose through parallel mutations in different populations, although all of them produce the same effect in transfusion. What is true of rabbits' hair may logically apply to human hair as well, and what is true of blood group A may apply to many other characters. If we use this principle of parallel, independent mutations producing identical effects in separate and genetically isolated populations, we can eliminate many of the headaches which come from trying to trace the origins and diffusions of specific somatic traits through time and space where historical records are lacking.

In the whole of nature, while the phenotype of any

* For example, Waardenburg,[83] has enumerated 200 known hereditary diseases of the eye, thus allowing at least 200 genes for that organ.

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organism can be described in varying degrees of detail, few total genotypes have been revealed. In fact, the only one of which this may be considered even approximately true is Drosophila, the fruit fly. We know little of the inheritance of observable physical traits in man, although beginnings have been made in such features as the distribution of body hair, details of eye color, and the presence or absence of an internal eye fold.

BLOOD GROUP GENETICS

Of all of the inheritable characteristics in man, only the blood groups have been studied all over the world in great detail. In the early nineteen-hundreds Landsteiner and others rediscovered the fact that when certain bloods were mixed, the red corpuscles became stuck together and could no longer carry oxygen. By experiment it was found that this property existed in a number of independent forms. The blood from one person could mix with that of certain other individuals, while with still others agglutination, as this dangerous condition came to be called, occurred. By learning what the combinations were, Moss and Jansky independently described four categories which are now called O, A, B, and AB.

It is now known that O, A, and B are genetically separate and that a person may inherit any combination of two of these genes from his parents. It used to be thought that O was merely the absence of A and B, but it is now believed that O is the result of a particular gene and that the tissues produce a definite O substance.*

* All of the so-called group-substances which are responsible for the various types of blood are found in a number of different kinds of body tissues and secretions, in some of which they are more concentrated than in blood. These include particularly bone marrow, semen, and brain tissues. The concentration in bone tissue is what has made it possible for Candela,[11] Laughlin,[44] and others to determine the blood types of ancient skeletons.

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Formerly, millions of persons died from loss of blood each year after surgery and accidents. Transfusions could save these lives, but only if the right groups of blood were transfused. Therefore hospital patients, soldiers, and ordinary people were "typed" and we now have data on nearly 100,000,000 people from all over the world. Once these data were available serologists and anthropologists discovered that the percentages of these groups differed among different populations, and followed a distinct geographical pattern. In general, throughout the world, O is marginal and A and B concentrated in the middles of continental areas or in centers of dense population and complex civilization. This made it appear as if these forms had some selective value over O.

Certain features, however, were puzzling: Congo Pygmies, Hindus, and Mongols share the world's highest incidences of B, while the three are at opposite corners of the human scale in external physical features, and presumably developed in mutual isolation. A is strong among Western Europeans, Australian aborigines, and a few American Indians. We now know that there are at least three kinds of A: A_1, A_2, and A_3. The last is very rare and as yet has no known racial significance. The distribution of A_2 is primarily limited to Europe and contiguous regions, appearing to a lesser degree in the Negro populations of Africa. However, in both areas A_1 is more common than A_2. In so far as is now known, A_2 is completely absent from the populations of eastern Asia, Indonesia, Melanesia, Australia and the whole of the New World. This is of considerable genetic significance. In these regions all type A blood is produced by the A_1 gene. In time the geographical riddle of blood group B may yield a comparable type of solution.

Following the O, A, and B series, serologists found

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several others which have differential world distributions, and the genetics of which are also understood. One of these is the M-N series; you can be M, N, or MN. What difference this makes is not known; the physiological expressions of the genes M and N have not been completely explored, but they cause no agglutination of the blood in transfusions and hence the distribution has not been intensively studied by medical men. Another series, however, *does* make a difference; this is the Rh or rhesus series, of which there are two major types, Rh positive and Rh negative. An Rh positive child born to an Rh negative mother by an Rh positive father may die prenatally or shortly after birth, owing to red cell destruction, and the mother herself may be damaged by antibodies developed by her child. Or the child may be feeble-minded. Serologists suggest that, in an inbreeding population living without modern medical care, either the Rh negative or the Rh positive group would in time be eliminated, depending on which predominated at the time when outside genetic influences were first barred. That this is true may be indicated by the fact that a number of populations in which everyone is of the same rhesus group have been found in remote places.

MUTATION AND SELECTION

Selection plays a large part in the changes which occur in the genotype, and hence in its phenotypical expression. But selection alone cannot produce changes of race or species; new genes must appear from which selection can be made. The appearance of new genes is called *mutation*. As far as we know at present, mutation is a change in the chemical composition of a gene, which in some if not all cases alters its capacity for behavior. Although the exact cause of mutation is not known, it is felt that natural

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radiation such as cosmic rays plays a large part in the process, while temperature may also contribute. Biologists have accelerated the frequency of mutation in organisms by quantitatively altering these forces. In each animal a characteristic mutation rate normally occurs; experts who study fruit flies know how often they can expect something new. In man it is believed* that the mutation rate is about one in 50,000,[31] which means that each of us, on the average, may possess a single mutation, new or repetitive. There are about three chances out of 100 that this mutation is concerned with a visible character, and that it is something as striking as a change in hair form or pigmentation is extremely unlikely.

Once in a "blue moon" some mutation turns up that has a selective survival value, and this is particularly true when the external environment of the organism is changing. After a pack of weasels has moved into country where the ground is covered with snow half the year, mutations in favor of a seasonal shift of coat color to white have less chance of being killed by natural enemies than their unchanged fellows. This simple, Darwinian example will serve to illustrate what happens in more subtle circumstances such as resistance to new parasites. That selection of this kind has happened to man cannot be doubted. The "goodness of fit" between racial varieties of the human organism and the varieties of environment, cultural and geographical, in which the organism lives, is too nearly perfect.

HUMAN BREEDING HABITS

The geneticist who studies the process of mutation and selection in a population must know the breeding habits

* Based on the occurrence of cases of hemophilia in which inheritance can be ruled out.

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of his specimens, since breeding itself forms one of the prime vehicles for selection. In fact, the principal tool of the geneticist is his ability to control breeding. While we cannot control breeding in man, we can observe it. In human populations, most fertilization undoubtedly takes place as a result of the cohabitation of husbands and wives. "The choice of spouses in any given social system follows one universal principle: the ideal or preferred mating is one which under normal circumstances will produce the minimum of disturbance to all persons in any way concerned."*

Father-daughter and mother-son marriages would start all kinds of trouble in a family in which both parents were alive. But in a family of apes, the father chases his son away as soon as the lad is old enough to cast languorous glances at his mother, and among monogamous apes such as the gibbon, the mother similarly ejects her daughter.[12] If the father gibbon is widowed at the time his daughter arrives at sexual maturity, union will occur; the vacancy in the family has been filled. While a human widower might also marry his daughter without creating disturbance in his *own* family, his act would be considered anti-social, irreligious, and immoral by the other members of the community, who would take steps to break it up. Unlike the anthropoid apes, men do not ordinarily live by single family units alone, but in communities of several families, and these communities are biological units with their own requirements for equilibrium and for survival, over and above the requirements of the individuals of which they are composed. One of these requirements is that rules which serve to maintain group equilibrium must be enforced, and that there be no exceptions.

The rules which concern mating vary as social systems

* Coon,[10] p. 602.

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vary. A social system in turn is a part of the total adjustment of a population to its landscape through the mechanism of culture. Cultures vary greatly in degree of complexity. However, for 99/100 of our history as a species, the time-span during which the bulk of the genetic changes which produced modern man must have taken place, the ancestors of all of us lived in primitive societies, and got their food by hunting and gathering. In such a society (as we deduce from those which have survived) a young man normally takes his bride from the next camp or village, just as his father did before him. Thus geographically unified clusters of camps or villages tend to become local breeding units. Within such a larger unit, meetings are held at times of seasonal abundance, and during these meetings fun and games are in order. Part of the sport includes promiscuous intercourse in violation of all the usual rules except those referring to the biological family itself; father-daughter, mother-son, brother-sister taboos are still in force, but otherwise every woman is given a chance to reproduce even if her husband is sterile, and panmixia within the breeding unit is approached. Just how closely it is approached would require statistical studies difficult to obtain under the circumstances.

SOCIAL SELECTION

A little easier to obtain would be data on the reproduction potential of persons with skills and personality traits different from the rest of their fellows. The best hunter in a small band often has the most wives; elderly couples like to give him their daughters. The successful war leader may be equally favored. Old men who are wise in tribal lore are often called on to divide the meat equably after a hunt, and to decide quarrels. These older

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men build up harems of young wives. The capacity of leadership, like the capacity to be led, may well be based on certain fundamental physiological rhythms, which could be inherited.

The selective values of social adaptations vary from such a simple advantage as the possession of a loud voice for shouting warnings to one's womenfolk over a long distance (and thus preserving one's chance of continuing to reproduce in a very thinly populated area), to the subtler implications of an ability to dance charmingly, and thus help maintain equilibrium in the society at hand, which also has a survival value in simple societies.

In small groups the efforts of each individual are important to the survival of the whole. Individuals who are incapable of getting along with the others may endanger not only their own lives but those of their fellow members as well. If a group includes many such individuals in a highly competitive environment, its chances of survival are correspondingly reduced. We know from case history accounts that among peoples who are hard pressed for food, like the Central Eskimo and the Australian aborigines of the Western Desert,[4, 67] troublemakers are killed. If the cause of their maladjustment is inheritable, and they are killed prior to fulfillment of their breeding effectiveness, their genes will have less chance of being passed on to the next generation.

ISOLATION AND INCORPORATION

Even in the most isolated groups such as we have just described, the gene pool from which selection must take place is enhanced from time to time by the introduction of new genes. Many primitives have rules of etiquette which require them to loan their wives to traders, visiting kin, and other honored guests, including explorers. These

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new genes will be subject to the usual processes of incorporation and selection.

When units of population which were originally related move apart geographically, and become exposed to different environmental influences over long periods involving many generations, groups of people who show physical differences result. These differences will be partly genetic. The genetic differences may in turn be due in part to mutation and selection, and in part to gradual intermixture with other peoples—guests and refugees from without, or "natives" found in the new countries into which the migration has occurred. Mutation without selection, known as random genetic drift, may also cause genetic differentiation.

Once installed in a new geographical environment, a group which remains isolated will eventually produce a population of individuals who resemble each other in most respects, and differ in certain respects from others whose racial history has been different. In the course of time, the frontiers of marriage and of local trade will come to coincide with the geographical boundaries within which the racial group is contained. Geography, culture, and race may thus acquire common limits at identical barriers. This acquisition, however, is a gradual process, which may often be disturbed, particularly in societies in the course of relatively rapid technological change.

CLASS AND RACE

Relatively complex societies, with a division of labor, hierarchies, and class systems, have probably been in existence for no more than 6,000 years, or 240 generations (equal to a decade for fruit flies). Some races have been exposed to the selective forces of these complex societies, while others have escaped them. In certain of these systems

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class prejudice has carried on where geography has left off; once physical distance has ceased to be a serious problem, social distance may replace it. Marriages between classes create the most disturbance, and hence are avoided.

Very often physical differences coincide with class differences and serve as labels, hindering mobility. In some societies, the classes have developed locally from a single population, as in parts of Europe. There the lower class is more poorly fed, and the only visible differences are those of gross size and such stigmata as rickets and poor teeth. Individuals meeting the standards of the upper class may learn to behave like aristocrats and move up without too much notice. In other societies the differences are of historic origin, and genetic. In some cases the upper class may be descended from conquerors who have subjugated a genetically different native population; in others, indigenous landowners may have brought in slaves, genetically different from themselves, from distant parts.

The American Negro illustrates the latter case. Here prejudice has been carried to such an extreme that the slightest visible physical indication of a partially Negro ancestry has become a symbol of class status. Under such conditions physical differences, which can be easily recognized, become symbols of social differentiation, and since they are genetically transmitted, help to perpetuate traditional social barriers. The Whites, however, are not always on top in cases of inter-racial segregation. In Ethiopia the Guraghes, who are probably the most European in appearance of all elements in the population, are hewers of wood and haulers of water. Among the Lolos, a feudally organized aboriginal tribe of Western China which has lived for centuries in great isolation in a mountain refuge area, the "white bones" or serfs, are more "European" in eye-form, pigmentation, and hair distri-

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bution than their masters, the "black bones" or nobles, who are more Mongoloid in these racial characters, and this can be shown by statistics.[63]

Sometimes, as in the Hawaiian Islands, the culturo-historical situation has been quite different; racial barriers have not been erected, free mixture has continued to exist since the introduction of the principal present-day racial strains, and Twentieth-Century class barriers which regulate the choice of spouses are built more on wealth, education, standard of living, and tradition of social importance than on race or ethnic origin.

The present trend throughout the world is toward a breakdown of lines of class and color. Differences of income brackets are being erased, and education is becoming more general. Systems change slowly, and "moral values" mirror systems. Race and culture are part of a single historical pattern, deep rooted in the past, pointed to who-knows-where in the future. This is the first time in history that men have begun to learn about their genes, and it may not be too visionary to suppose that one day we shall tamper with them.

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Chapter 3

Adaptive Changes in the Whole Body

THE RELATION BETWEEN ENVIRONMENTAL AND ORGANIC CHANGES

CHANGES in the genetic make-up of human beings have been taking place for hundreds of millennia, through the processes of mutation and selection without the intent or even the knowledge of man himself. A reason for this is that human beings, like all other organisms, live in specific physical environments which are not all alike. Whatever the details of the mechanism involved, differences between genera, species, and races have arisen in response to kinds of environmental change, and this is as true of man and related primates as of any other animal.

The first effect of an environmental change is felt in the way in which an organism works—in its physiology. If the organism adjusts itself successfully to this change, the alteration of its physiological processes may require an immediate anatomical change in one or more organs, and this organic change may in turn involve a modification of the bony framework which holds the organs in their effective positions—the skeleton. An increase in lung size, such as accompanies high-altitude living, may be reflected in an enlarged thorax, a greater sternal angle, jutting ribs, and a raised rib cage.[45] The need for sufficient oxygen ends up in a bigger chest. Thus the sequence of events in change goes from physiology to soft-part anatomy to the skeleton, and the most durable portion of the entire animal is the most plastic of all, and the farthest removed from the specific cause of change.

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The environmental shift which permits these changes may be a geological change, the succession of glacial and interglacial, pluvial and interpluvial periods in the Pleistocene, or of man's practice of walking from one climatic area to another at any period. Migration between climatic zones is of course a much more rapid process than climate change in a single area. A shift of environment, however arrived at, may be expected to produce corresponding alterations in such physiological processes as activity rates, blood chemistry, and the reaction of living tissue to different degrees of heat and light radiation in the development of pigment, in fat storage, and in some aspects of growth and maturation.

These physiological differences are the very stuff of which racial variations are made. The significant elements in the natural environment, the "great outdoors" in which we live, the factors which, as they vary, produce responses in living beings, include the various kinds of rays which come from the sun, radiation from outer space, the amount of water held in suspension over the earth as part of its "atmosphere," the density of the air at different altitudes, and the minerals held in solution or suspension in water and in the soil, which human beings assimilate through food and drink.

Different combinations of some of these factors, notably latitude, altitude, the presence of land masses and bodies of water, prevailing winds and ocean currents, etc., produce variations in temperature, precipitation, and plant life. By means of these, geographers divide the land surface of the earth into climatic zones. We do not know exactly where our primitive ancestors evolved into ground-living, erect-postured hunters and gatherers, but we can specify the kind of climate which they needed. It must, first of all, have been warm. We know this because all of the

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other higher primates (orang, chimpanzee, gorilla, gibbon) live in tropical or subtropical climates.

Our pre-human ancestors may well have had cover hair, like the living great apes, and like those of us whose bodies are hairy. But the hirsute chest and back of an Ainu, an Australian aborigine, a Scotsman, or a Jew keeps him no warmer than the sleek glabrous skin of a Polynesian, a Negro, or a Chinese. A beard is no real protection against the cold. By the time human beings were ready to move into cold climates, they had already adopted technical means of preserving body heat, such as houses, clothing, and fire. Thus two things could happen: (1) the organism could survive far outside its original environment; and, (2) it could be subjected to greater extremes of environmental variation than any other mammalian species. That is why human beings vary so greatly in appearance.

Temperature, the most easily measured variable in the environment, cannot be considered apart from humidity. When the temperature of the air falls, the moisture content of the air is correspondingly reduced. Dry temperatures as low as −96° F. have been recorded in Siberia. You cannot freeze your ears on a damp day, no matter how chilled you may feel. On the opposite side, a temperature of +91° F. at Belem, Brazil, where it is usually very moist, will enervate most human beings. The same is true on Guam, in Baltimore, or in Boston. In Marrakesh, Morocco, or Merced, California, where it is always dry in the summer and the noonday heat may rise to 120°F. in the shade, this temperature causes less discomfort and less loss of energy.

In tropical forests the temperature rarely rises to 90° F., well below body heat. But the saturation of the atmosphere prevents heat loss through evaporation, and causes dis-

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comfort unless there is a breeze.* In deserts, where the temperature has been known to reach 136° F., evaporation takes place readily and people feel less uncomfortable. The variable components of the atmosphere—heat, light, and moisture—are not the only portions of the natural environment which affect man. He also has to supply his body with energy. Although the source of all energy in the biosphere may be solar, nevertheless that which is used within the organism must be drawn through the intermediacy of the soil, through the water that people drink and the food they eat. While rain water is nearly pure, being distilled by the sun's rays, it picks up many mineral elements and holds them in solution, as it drains over the soil and becomes concentrated in lakes and streams. Of these minerals the most important yet known are calcium and phosphorus for bone building, iron for oxidation in the lungs, iodine for the production of the thyroid hormone, and the trace elements, manganese, copper, zinc, and cobalt. The exact functions of these last four are by no means clear. Much work is being done on the subject at present.[79]

The proportion of these various elements varies both in space and in time. We have all heard of "hard" and "soft" water, and of the high fluorine content of the water in Deaf Smith County, Texas, and its presumptive effect on tooth enamel. Eighty years ago Collignon and others showed significant differences in stature in France between the people who lived in granitic and those who lived in limestone soil areas.[14, 40] Similar results, as yet unpublished, have recently been obtained in the Balkans.

The influence of the minerals in the soil may come not only through water drunk, but also through food eaten, through vegetables grown in the soil, and through the

* Wulsin,[81] p. 38.

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milk and flesh of animals fed on grass and grains which grew on the soil. Marett,[59] in a little-appreciated book, has made sweeping predictions about the effects of different minerals on the human physique. We all know that differences of environment affect sheep and cattle, and some of us even realize the effects of such short-range variations as the use of manure *vs.* artificial fertilizer on the growth of plants and hence animals,[41] but most people are reluctant to admit that these influences affect human beings. It is easy to say that such differences, being environmental, are not hereditary. One must remember, however, that some organisms can live on short rations better than others, and that this kind of selection may well cause a genetic change in a population when its nutritional environment is changed.

VARIATIONS IN TOTAL BODY SIZE

Turning from generalizations to cases, we know that human beings vary enormously in gross size.[52] In our own country it is not unusual to find a husband weighing twice as much as his wife. The mean stature for Montenegrin males in certain tribes is nearly 180 cm., while in parts of Sicily and Southern Italy, only two or three hundred miles away, the mean for adult males falls to about 160 cm. This is a difference of approximately 20 centimeters, or one part in nine. The weight and volume differentials are greater, since they vary as the cubes of linear dimensions.

Racial differences in size make deep impressions on people, particularly on those who are smaller. In many environments the big man is at a distinct physical disadvantage, but he may be able to force the smaller to do his work for him. All over Europe the upper classes are taller than their less favored compatriots, partially on account of better nutrition.[80] In Arabia the tallest people

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are the sheikhs, whose principal activities are political and military. The social and political values of size differentials must not be forgotten.

THE PYGMIES

The smallest peoples in the world are the Pygmies, who live in patches of tropical rain and monsoon forest from Africa to New Guinea. Adult male Pygmies of the Belgian Congo average under 150 cm. in height, and weigh no more than 100 lbs. These little people are perfectly proportioned; they are neither infantile nor deformed. They are simply small people. Perhaps they have always been small, and were left behind in body size while others grew larger. Perhaps some selective agency reduced their bulk. It is hard to lay their size to mineral deficiency, for other animals in their environment are normal for their genera, including the elephants.

The African Pygmies hunt. They provide their Negro neighbors with meat, and the Negro neighbors give them bananas. Thus both eat the same food, although perhaps in different quantities. The Negro neighbors are about 10 to 15 cm. taller than the Pygmies, but they are also shorter than grassland Negroes. Either (a) the environmental influences which make the Pygmies small also operate on their Negro neighbors, or (b) the Negroes have taken enough Pygmy wives to reduce their stature mean, or both. The second hypothesis can be proved, the first cannot. Nor can it be shown false. The truth of the matter is that we do not know why Pygmies are so small, and we would like to find out.

RICE AND REDUCED SIZE

All the way from Sumatra to Japan, along the island fringe which skirts the Asiatic continent on the east, one

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finds populations living on polished white rice. The same is true in southeastern Asia and southern China. Whatever their other racial characters, these people are all short, particularly those on the island periphery; they range from 155 to 162 cm. in stature. It would be hard to lay this to the soil, for that varies from place to place. It cannot be explained entirely by the fact that all of these people are to some degree "Mongoloid," for the North Chinese, who are also Mongoloid, are tall. The only thing that all these people have in common is the habit of eating rice.

The experiences of the last war have taught us much about the rice diet; adult Europeans raised on richer foods can not subsist on it and remain healthy. On the same diet, Europeans will develop pellagra, black-tongue, hyperkeratosis, and staggers, while habitual rice eaters go on happily. American, British, and French prisoners in Singapore, China and the Philippines proved this.

Experimental animals brought up from the time of weaning on a diet sufficient to maintain life but low in amino acids are smaller than control animals of the same genetic strains, as has been shown by Rose.* Talbot,[80] quoting Brasch, suggests that children fed on a minimum low protein diet mature later and are never as tall as children fed on an ample or superior protein-rich diet. Thus rice with its unique life-supporting character may produce small but viable people who might grow considerably bigger on an American diet. In fact, there is good evidence that they do.[53]

The problem we next have to face is why the rice eaters do not suffer as Europeans do from the diseases listed above. Talbot suggests that individuals can adapt themselves to special diets of this kind if they start early enough in life. Further, a rice diet is sufficient to provide mini-

* Rose,[79] p. 292.

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mum life-maintaining essentials, as has been shown in its recent use in American hospitals to relieve hypertension. Naturally, vitamin supplements are necessary for Americans on this diet; native rice eaters may need less—in their homeland diets they add greens and small amounts of meat, as well as green tea. During World War II the Russians employed spruce tea as an antiscorbutic. The white men fed rice by the Japanese in prison camps did not receive these dietary supplements, and their minimum requirements were almost double those of their captors, since caloric requirements are a function of the eater's volume, all else equal. The genetics of this medical problem, when we learn them, may help us to test this theory of selection and adaptation to the Asiatic rice economy, and to discover whether or not some of the racial features of the world's most numerous population are dietary in origin.

Tropical islanders who live in Polynesia and Micronesia, and whose ancestors are supposed to have come from Java and its general region, are as tall and as heavy as Western Europeans and Americans. Instead of rice these people base their diet on sweet potatoes, yams, and taro, supplemented with coconuts and fresh fish and molluscs.

Not only are these roots richer than rice in certain essential amino-acids (sweet potatoes are good sources of tyrosine and tryptophane*) but the sea-food protein supplements contain an unusually rich and diverse supply of amino-acids, as well as bone-building vitamins, calcium, phosphorus, iodine, magnesium, and many trace elements. This difference also appears in the size differences between inland and coastal peoples of some of the larger South Sea Islands, such as Bougainville and Yap. This

* Based on experiments performed by Mrs. Naomi C. Turner of Forsyth Dental Infirmary, Boston, Mass.

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picture has two aspects, the total nutrition, and the genetically controlled efficiency of food utilization.

MID-LATITUDES AND MEAT

When early explorers of our western plains first saw the Sioux and Blackfoot and Crow, they were filled with amazement at the huge and massive builds of these bison hunters. Men often six feet tall (178-180 cm.) and over 200 pounds in weight, with huge heads, long, broad faces and craggy noses, and bony, muscular, solid arms and legs met their view. These Indians were and are magnificent physical specimens. So are the Tehuelche and Puelche of the Pampas, and the Ona of Tierra del Fuego. So were the Cro-Magnon people who lived in Europe in Upper Pleistocene times, and who hunted horses and mammoths on the Moravian Plain.

If we seek to discover what these various peoples have had in common, we find that they were all great hunters and meat eaters living in mid-latitude grasslands or forests; in areas with a seasonal change of temperature, with warm summers and winters cold enough to require clothing. The soils from which their food was derived were not deficient in calcium and other minerals. The alternations in temperature required neither excessive heat loss nor adaptations for heat conservation. The lives they led required a maximum of physical strength and endurance. An Ona woman, for example, must carry a load of 200 pounds from camp to camp. Her husband shoots guanacos of nearly equal weight and has to bring them home on his shoulders.

The Plains Indians handled bison, no flimsy beasts, and the Europeans of the Aurignacian period dealt with even larger animals. All of these peoples of whom we know are hand-to-hand fighters. Which, if any, of these factors

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made these people muscular and heavy remains to be determined.

ENVIRONMENT MODERATE: SIZE MEDIUM

Moderate in size, intermediate in build, and unspecialized in any of the ways we have named, are the peoples of the Mediterranean littoral and the Middle Eastern mountains from Palestine to Northern India. These are the people whose ancestors developed the basic principles of our modern civilization, and who have probably deviated less from an ancestral human habitus of any in the Old World. There has been no particular reason for them to change. They have encountered no critical extremes of heat, light, humidity, or other body-influencing natural phenomena. Their diet, basically cereals and legumes with meat and milk products, contained a balance of nutritive elements suitable for life in their environment.

MINERALS

If one goes to Corsica, however, one is immediately impressed by the number of really short people living on the island. They are Mediterranean in skull form and facial features, yet absolutely small. Over on the Balearics, people whose faces look much the same are often tall. As far as we know, both were originally settled by the same Mediterranean population. Corsica is a remnant of an old geological land surface, composed of granites and other ancient igneous rocks, and incapable of growing much in the way of crops. That is why the island is covered with maquis, or brush, and given over to pasturage for goats, while other Mediterranean islands with different geological foundations are intensively tilled.

It is a mistake at this stage of our knowledge to ride the horse of soluble minerals in the soil too far. Very little

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real evidence is available. However, areas deficient in these particular minerals are usually inhabited by poor people. We do suggest, however, that soil content may have some influence on stature in Northern Albania, where other explanatory factors are hard to find. The Gheg mountaineers of this region have formed a locally inbred population ever since the Halstatt Iron Age. Their country varies greatly in geological composition. In the northwest, in Malsia e Madhe and parts of Dukagin and Malsia e Jakoves, limestone prevails; to the south, serpentine; to the east, metamorphosed Mesozoic rocks. The distribution of stature follows the geological areas closely, cutting across tribal divisions, and separating intermarrying villages.[17] The difference in stature between related segments of a single genetic population who live on different soils amounts to 6 cm.

It was possible to make this study in Albania because we know that at the time the men measured were growing up they obtained all of their food from their own village territories, except for a little tea and refined sugar. We are reasonably confident that their diets have influenced their regional stature means, but we do not yet know whether these differences are selective and hence inheritable.

If we study the distribution of body size among the present inhabitants of the United States, including only the native born of native parentage, we find less variation over three thousand miles than in twenty miles in Albania. The reason for this is manifest. Let each reader consider where each item in his daily food has come from. Orange juice—Florida or California. Cereal—the rich prairie soil of the Dakotas, or the black earth of Iowa, or both. Milk—probably Wisconsin or Minnesota, or upper New York State, Vermont—some northerly meadow country. Bacon

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—hogs corn-fed in Illinois, or garbage-fed in the towns outside Boston, in which case the garbage represents a nationwide nutritional roundup. One could go on like this for several pages, but the point by now should be clear. We eat food including meat, animal by-products, cereals, vegetables, and fruit, from every part of the United States, and from some other countries as well (for instance, bananas). We eat much. We take vitamins, some of which may be useful.

Like other populations we are variable. Some of us are large and others small; on the average we are tall and heavy, 174 cm. and 155 lbs. for young male adults.[66]

If we look at the more recent arrivals, we see rapid changes in progress. Second and third generation Italians, Portuguese, and Jews are far surpassing their European cousins, and their mean statures begin to approximate the North European means. North Europeans too are bigger here than their stay-at-home relatives in the old country.[7] Only the substandard poverty-stricken element among the American Mexicans is notably shorter. Otherwise, the American uniform diet is a great leveller; the melting pot works so far as stature is concerned.

ALTITUDE

A half century ago William Z. Ripley[69] made the observation that the whole mountain zone between southern highlands and shorelands and the plains to the north, from western Europe over to the Himalayas, was the home of stocky, big-chested peoples whom he called Alpines. He further ventured the opinion that their body form has something to do with the altitude. This environmental point of view soon went out of fashion and his remarks passed unheeded. However, high altitudes do have some effect on the human organism.

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High altitude peoples are noted for their excessive chest diameters as well as for their surefootedness. Both qualities are necessary to survive on high. Spacious lungs and a high vital capacity make up for the lowered oxygen supply. Now there are several ways to make up for the reduction in number of O_2 molecules available for the bloodstream. The heart rate can increase. The vital capacity can increase. The breathing rate can increase, or the hemoglobin content can increase. Cardiologists and Aviation-Medicine men have investigated these possibilities. They have found that increasing the heart rate—"tachycardia"—is fatiguing and positively dangerous; similarly increasing the vital capacity is more profitable than the exhausting process of breathing more often. Excessive breathing would result in a diminution of pulmonary CO_2 (which serves as a stimulus to breathing) without assuring adequate O_2 at high altitudes. At this rate the poor mountaineer would breathe rapidly, gasping for breath the while.

It is interesting to wonder whether there had been a positive selective force in operation on Early Man prior to his reaching the Andes and the Himalayas—did the exigencies of the atmosphere select brachypulmars (barrel-chested people) to the exclusion of flat chests; did the selection weed out long-bodied flat-chested children of yodeling mountaineers, or did disease reduce the flat-chested population, leaving only the barrel thoraxes behind?

To at least one of these changes, the need for an increase in hemoglobin, the body usually adjusts itself in a few weeks. But aside from purely mechanical considerations, the business of lung size and lung shape may be related to selection and survival in quite another way. It has repeatedly been shown that tuberculosis, particu-

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larly apical pulmonary tuberculosis, is most frequent in individuals with long narrow lungs in a long narrow thorax. The American Medical Association's Journal[21] has gone so far as to suggest a mechanical etiology. Now tuberculosis is a disease of the relatively young post-adolescent individual; and selection works most rapidly when individuals are removed from the population before they have had a chance to beget or produce offspring.

MOISTURE AND THE LUNGS

It is interesting to review the sections of the world where flat-chested peoples abound. They are generally dry places, especially hot dry places. Desert Australia, Arabia, and the Sahara have flat-chested inhabitants. Hot dry places give the Koch bacillus the least chance for transmission. Pygmies, Forest Negroes, Dutchmen, Bog Irish, Japanese, Polynesians, Filipinos live in moister environments and they all show broader deeper chests. And mountains likewise are never dry—their heights gather clouds. It is in mountains that both storms and deep-chested people are bred.

DRY HEAT—DESERT ADAPTATION

Within the confines of a given zone of environment it may be some culturally determined factor, like the choice of food grown, or its importation from elsewhere, that determines body size, rather than the unaltered, or unprocessed, attributes of the environment itself. One kind of environment, however, appears to produce special effects on all those who live in it for many generations. That is the extreme, the rigorous environment of the hot desert. The famous Tuareg of the Sahara reveal themselves, when shorn of their robes and veils by the anthropologist, to be tall, lean, skinny men, with long arms and

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legs, short, shallow bodies, and narrow hands and feet. The average adult male European who tries to wield a Tuareg sword is unable to compress his hand into the space meant for it on the hilt. The Tuaregs have only been living on the desert for 1300 years, since the introduction of the camel from Asia. Their ancestors were Berbers from the Moroccan Middle Atlas, and facially they still look like Berbers, and they still have a large minority of blue and green iris color, like their mountain kinsmen. But the Middle Atlas Berbers who live in cool forests and grasslands have a normal body build, legs as short and hands and feet as wide as those of a normal European.

The Somalis of the desert regions of the Horn of Africa are built very much like the Tuareg; and so are the Australian aborigines who inhabit the desert regions of northern and central Australia. Precise evidence from desert-living American Indians is not at hand, but we understand that long limbs and narrow extremities characterize such peoples as the Seri. Zoologists and paleontologists[57] know that animals that live in deserts tend to have long, slender, light-boned bodies, with the emphasis on length and slenderness of the limbs, while animals that live in lush, moist environments tend to be heavier boned. That this principle should apply to man is not surprising.

All the peoples just mentioned are literally *skinny*. Their skin surface area is great in proportion to their volume and weight. They are not tall; high stature does not necessarily go with this kind of build. The critical factor seems to be for the organism to present the maximum skin surface area in proportion to mass and weight to the external environment, thus permitting a maximum of cooling surface for evaporation (Fig. 1). Now 50 per

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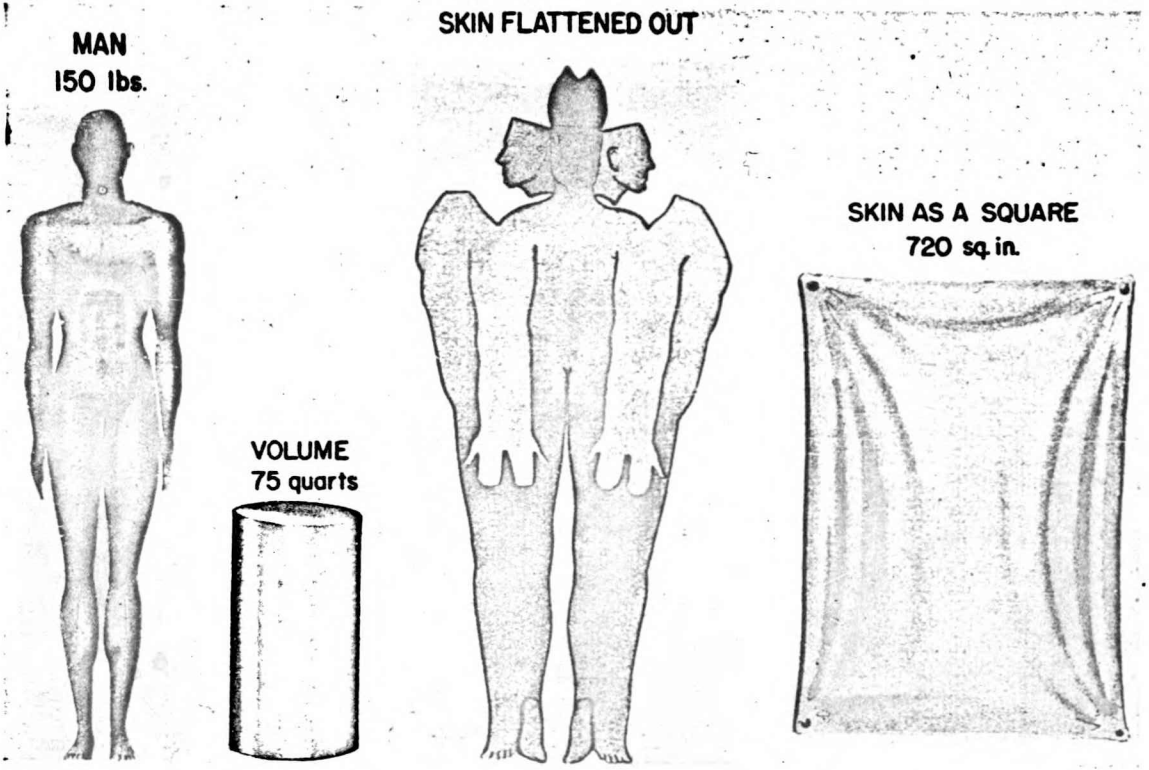

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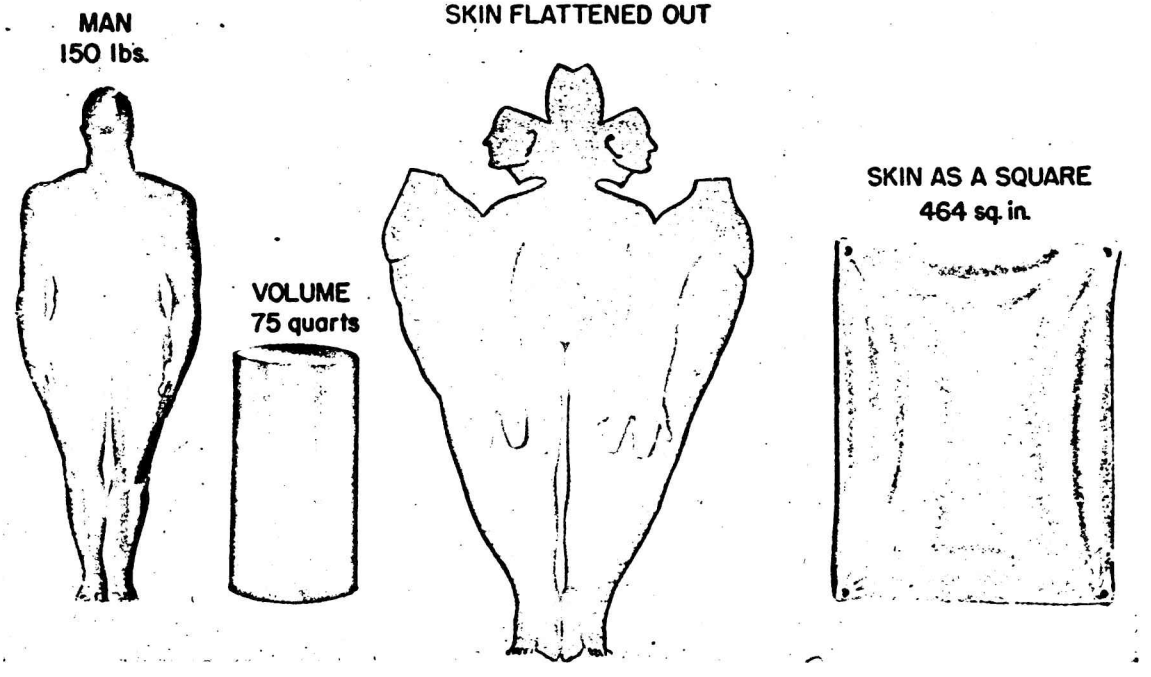

FIG. 1. Body volume and skin surface area. With constant volume, the more linear individual has the larger surface area.

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cent, more or less, of the body's blood is inside of the legs at any given time. A long, pipe-like leg is an excellent radiator; it exposes much more cooling surface per unit of weight and volume than a short, barrel-like one, which may be more useful in other environments.

Looking at the information which we have at our command, environmental, cultural, and anatomical, for all continents, we can see that there is a three-way correlation between food, body form, and desert living and it is not possible to separate out the independent variables. Suffice it to say that desert dwellers are forced to live on concentrated low-bulk, high-protein, high-fat and high-sugar diets; for example, in Arabia and the Sahara, milk and milk products, dates, and some grains are the foods of the desert dwellers. Bulky, high-cellulose fruits and vegetables, which do not grow in deserts and are hard to transport, are off their menu. A long-gutted organism, like a gorilla, can operate efficiently on high-bulk, low-concentrate diets. A short-gutted, narrow organism like a weasel requires more concentrated food.[28]

DAMP HEAT

Peoples who live in moist heat, like the Pygmies and Forest Negroes of Africa, the Indonesians and Melanesians, and the Indians of the Amazon-Orinoco basin, do not exhibit this lanky desert form. Their bodies have less heat and more humidity to cope with. Heat loss cannot, it seems, be increased through an increase of relative surface area, owing to the difficulty of evaporation in a nearly saturated atmosphere.[91] These people show no clear adaptation in body form to their special environment which, it must be remembered, was the original environment in which the ancestors of man lived before their descent from the trees. The living genera of anthropoid apes show

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a great range of body form in this environment. Their differences in shape seem related to means of locomotion rather than to the factors considered above.

EXTREME COLD

Another environment which leaves its mark on people is that of the Arctic. We must remember that human beings were not able to live in climates involving extreme seasonal cold until they had attained a level of technological skill necessary to make warm clothing. Otherwise they could not have left their houses or caves to go hunting in the middle of winter. Here again the time factor is short compared with the time span of human evolution, but still it gives us between 700 and 1000 generations. All of the people living around the Arctic Circle, from North Cape to Greenland, are short. They vary from 154 to 164 cm. in stature means, with few absolutely tall individuals. They include people whose ancestors have moved into this region in fairly recent times. In Norway the population of Finnmark is much shorter than that of the more southerly provinces, and the Norwegian settlers themselves are shorter than their relatives farther south. In Siberia the Yakuts, Turkish herdsmen forced north by the expansion of Genghis Khan's empire, are shorter than their kin on the grasslands to the south. It is probable that Russian colonists, several generations on the spot, have lost stature as well. In Greenland we have statistical evidence of the gradual reduction in stature among the colonists from Iceland, up to the time of their extinction.[33] Iceland itself, warmed by the Gulf Stream, does not fall in the stature zone with which we are concerned, although there is evidence that a temporary change of climate during the Middle Ages was accompanied by an equally temporary depression in stature.[72]

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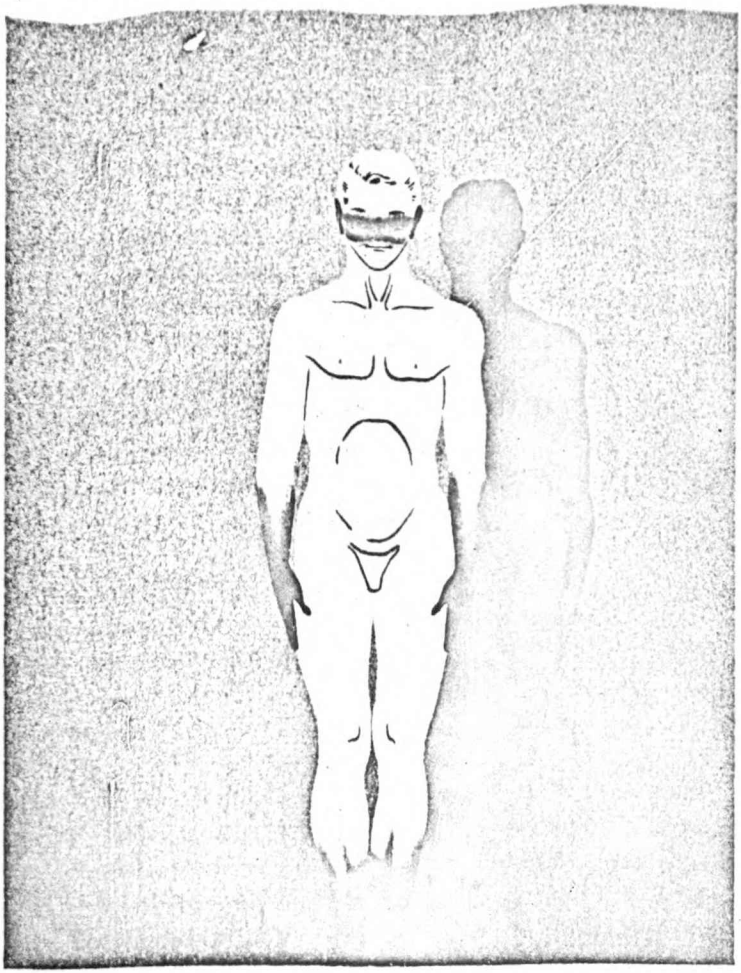

Fig. 2. Critical areas for cold—the extremities, the nose, eyes and the middle face.

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The short peoples who live around the Arctic Sea are also uniform in another respect: they are thick set. Their bodies are chunky, their chests thick and wide, their legs short and thick, their fingers and toes short, and their wrists and ankles small and fat-covered. Even so, in Alaska surgeons on ships and in mission stations amputate many frozen toes from Eskimos; this is said to be their commonest operation (Fig. 2). In contrast to the inhabitants of overheated deserts, Arctic peoples present the least possible skin surface area to the outside world, in proportion to volume and weight; and even that surface they keep covered, except for their faces, when outdoors in the cold. They are built to radiate as little heat as possible. As it is, much of the animal fat eaten by an Eskimo or Chukchi is expended in heat loss, for they have almost twice the caloric requirements of people living in our environment. Any eyewitness account written by explorers will mention the enormous quantities of fatty foods which these people eat. Some of it they store. When they are young and in their prime they tend to be fat-protected as well as muscular. Old age brings a loss of fat under the skin, wrinkling, and general inability to withstand the rigors of the environment. Death comes early; few live to be really old.

Why Arctic peoples are relatively globular is clear enough; *how* they became so is harder to answer. However, we know enough about the physiology of heat loss to venture an explanation. Individuals who exhibit the minimum surface area for their volume are those who have the least prominent surface projections, and the maximum development of visceral protection. This is like insulating the furnace to save heat. Sleep studies have shown that during slumber the temperature of the extremities approaches outside air temperature, while the

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viscera are maintained near the waking temperature. Short extremities are less likely to cool to a dangerous level than long ones, particularly if the bones and blood vessels are well covered with fat and muscle.

A second possible effect of cold is its influence on the growing organism: through stimulation of the adrenals and their secretion of cortical hormones, and the consequent storing of fat, building of muscle, and early closure of the epiphyses of the long bones. This may help make Arctic peoples short and relatively globular. This effect may be considered as a temporary or phenotypical change which might be altered dramatically by changing the environment of a child at an early age, and leaving the more-than-adequate diet constant.

Arctic-dwelling peoples sometimes go hungry, and many die of starvation.[67] Selection would favor those who could store and utilize fat, as it would those who could escape freezing their extremities. In the siege of Leningrad, women suffered less from starvation than men, presumably because of their greater fat reserves per unit of body weight.[34] Dickerson and Gowen[19] have described a breed of mice which show a hereditary ability to utilize food more efficiently and thus develop "obesity" than other breeds fed on the same diets. Such a capacity, while unpopular in our society, is of unquestioned survival value in others where food is scarce.

Starvation is a powerful force in natural selection, in man as in other animals. This principle is a general one and must apply to other peoples outside the Arctic area who are of interest to anthropologists. Many "primitives" grow fat when they are taken off the range and put on reservations. Some who live on deserts and are at the same time exposed to starvation develop concentrations of fat

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in special areas, especially the buttocks, while the extremities are not affected. This combination is found among the South African Bushmen.

A CLASSIFICATION BASED ON BODY BUILD

Were one to classify mankind on the basis of body build, it would be easy to visualize four categories. At one extreme (#1) would be the Arctic peoples, long-trunked and short-legged (Fig. 3a). At the other (#4) the desert folk, such as the Carpentarians and Tuareg, would appear (Fig. 3b). Mediterranean peoples of Europe, North Africa, and the Middle East would fall largely in class #3, while #2, moderately thick-set peoples, would be found among many Northern and Central Europeans, Southeastern Australians, Neanderthal Man (judging from skeletons) and early South African men who survived until at least 300 years ago—the Boskop people. These peoples show a physical form suitable for cold adaptation—not the extreme cold of the Arctic and periglacial regions, which can be survived only with Eskimo suits, blubber lamps, and the like, but a cold such as we who live in the Northern United States know, or that in which the Onas of Tierra del Fuego live though equipped only with windbreaks, wood fires, and untailored fur robes. We must remember that although the geology of these places has not yet been worked out to everyone's satisfaction, Southern Australia may, during the heights of the last glacial period, have been quite cold in winter, despite the absence of local glaciation.

THE GENETICS OF BODY FORM

In this last section we have stressed the role of environment in the production of different human pheno-

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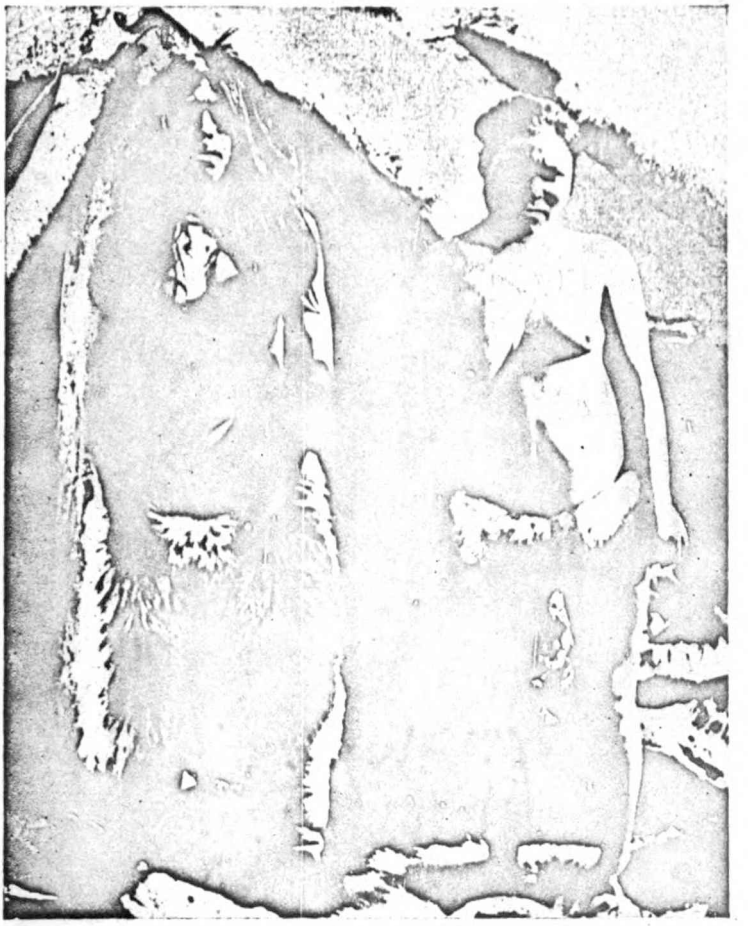

Fig. 3. Extreme types of body build. (a) Eskimos (Courtesy Nationalmuseet, Copenhagen).

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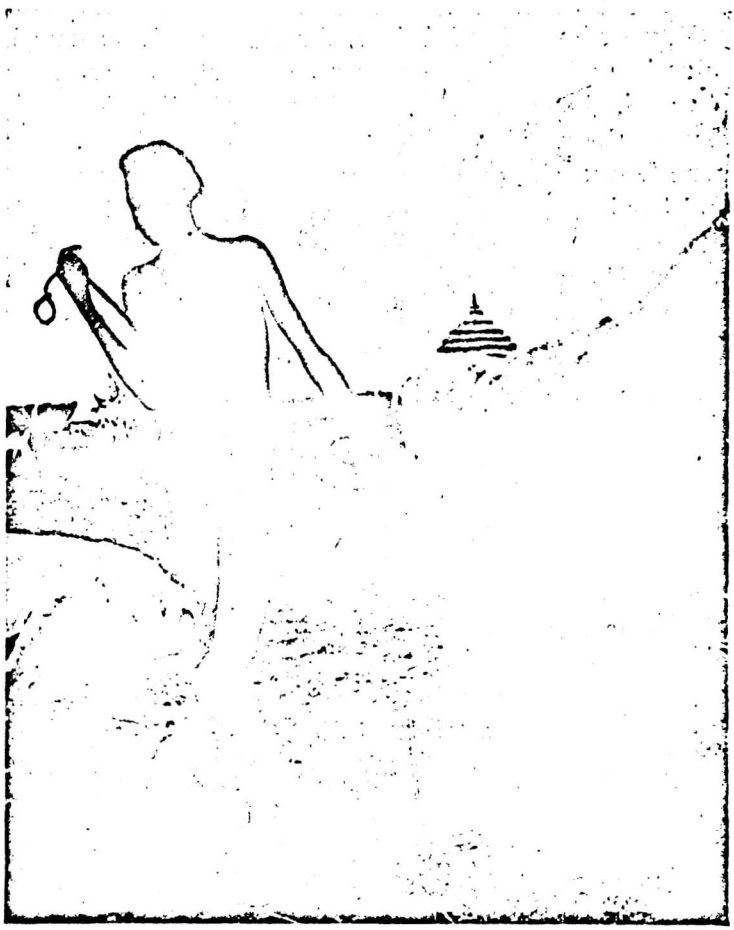

(b) Nilotic Negroes (After Evans-Pritchard, 1940, Plate 3).

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types as far as size and shape of the entire body are concerned. We have not, however, left heredity out of our calculations.

When climate is salubrious, the organism is not taxed, but when climate becomes severe advantageous mutations have a higher selective value. Thus such climatic conditions as the arctic and the desert provide are able to alter gene frequencies for the shape and size of the organism, and its physiological properties, more rapidly. While it is the gene that is selected, it is color, shape, and size that we see. The speed of selection, unlike the mutation rate, is not constant. Some environments select more rapidly than others.

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Chapter 4

Surface Variations: Adaptations to Excesses of Light and Heat Under Different Degrees of Humidity

LIGHT AND PIGMENT PRODUCTION

WE have seen how stature and body proportions, independently of evolutionary status, appear to respond readily to environmental stimuli and limitations. Another whole group of physical characters in man seems to have made similar responses. These are the surface characters of the skin, hair, and facial features. They are what are usually considered to be the prime criteria of race. Much more strictly than the criteria dealt with in the last section, they are controlled by inheritance. Much less easily can they be shown to have been produced by the requirements of the environment on the organism. In these characters we are concerned little if any with altitude, moisture, or soil minerals; what seem important are extreme or threshold conditions of light and heat under varying degrees of humidity.

The effect of light on the human organism is probably even more important in causing racial variations than heat. We know from many studies of lower organisms that tissues sensitive to light usually develop pigment. Our own skins become darker when exposed to ultraviolet light, and bleach in the winter. In our eyes, the posterior layer of the iris is always covered with a layer of pigment, except in albinos, whose eyesight is defective in opera-

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tion. Although their retinal capacities are normal, in natural free life their vision is impaired by scattered light ordinarily excluded by pigment. In normal individuals the iris pigment keeps the sunlight out of the inner chamber of the eye, except that which enters through the pupil; the iris dilates and contracts with variations of light, like a camera diaphragm. Thus pigment in this iris layer has a definite light-regulating function.

DIFFERENCES IN LIGHT QUANTITY IN SPACE AND TIME

Differences in amount of light, including both visible and invisible segments of the spectrum, are great in different environments. On a bright clear day on the African desert, there may be 200 times as much visible light as on a dull day in February in Boston. We know that superficial pigment in animals is related in various ways to light, just as chlorophyll is in plants. In general, its principal function in animals is to protect tissues from excesses of ultraviolet light, particularly from the narrow but harmful segment of the spectrum lying between 2700 and 3000 millimicra.[56] There can be little doubt, therefore, that racial differences in skin, eye, and hair pigment in man are likewise affected by variations in solar radiation. It is easy to see that chocolate-brown pigmentation of the outer or front layer of the iris, which occurs among people who live, or have lived, in equatorial regions, can serve to reenforce the pigment in the back of the iris, to make that organ a more effective light shutter. On the other hand, a blue eye is one on which there is little pigment in the front of the iris, or none at all. Although blue eyes turn up in all populations studied which have not acquired the chocolate-brown type of dark eye, they are numerically predominant only among people whose ancestors have

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lived in historic times in that part of the Old World covered by ice during the last glacial advance. It is probable that the ordinary "brown" eye possessed by the majority of human beings is a holdover from our primate ancestors.

The distribution mentioned above provides the key to a further consideration, that of *time*. We are living in a geologically intermediate period, so far as heat and light are concerned. Our present period is an interstadial, half way between a full glacial advance and a full interglacial. Man has survived both of these last named extremes, and it is more likely that changes in pigmentation and other characters due to great heat or cold, and to comparable extremes in light radiation, took place during earlier and more extreme geological periods. The great transfer of populations which began after the invention of gunpowder and the period of navigation and exploration initiated by the da Gamas and Columbus, and which brought European settlers to all climes, and the Negro to America, is only a dozen generations old. To the biologist who studies mutations in the laboratory, using insects and mice, that is the equivalent of a year or two.

DEEPLY PIGMENTED SKIN[26]

Individual human beings vary greatly in the concentration of melanin which originates in the germinative and moves into the granular layer of the epidermis. Albinos have none at all; white people have varying quantities, while the lower layers of the epidermis in Negroes and some Negritos are packed with it (Fig. 4). The amount of pigment deposited is inherited, but not as a single factor.

Dark skins obviously absorb more visible radiation than do lighter ones. If albino skin is rated as 1, then nearly

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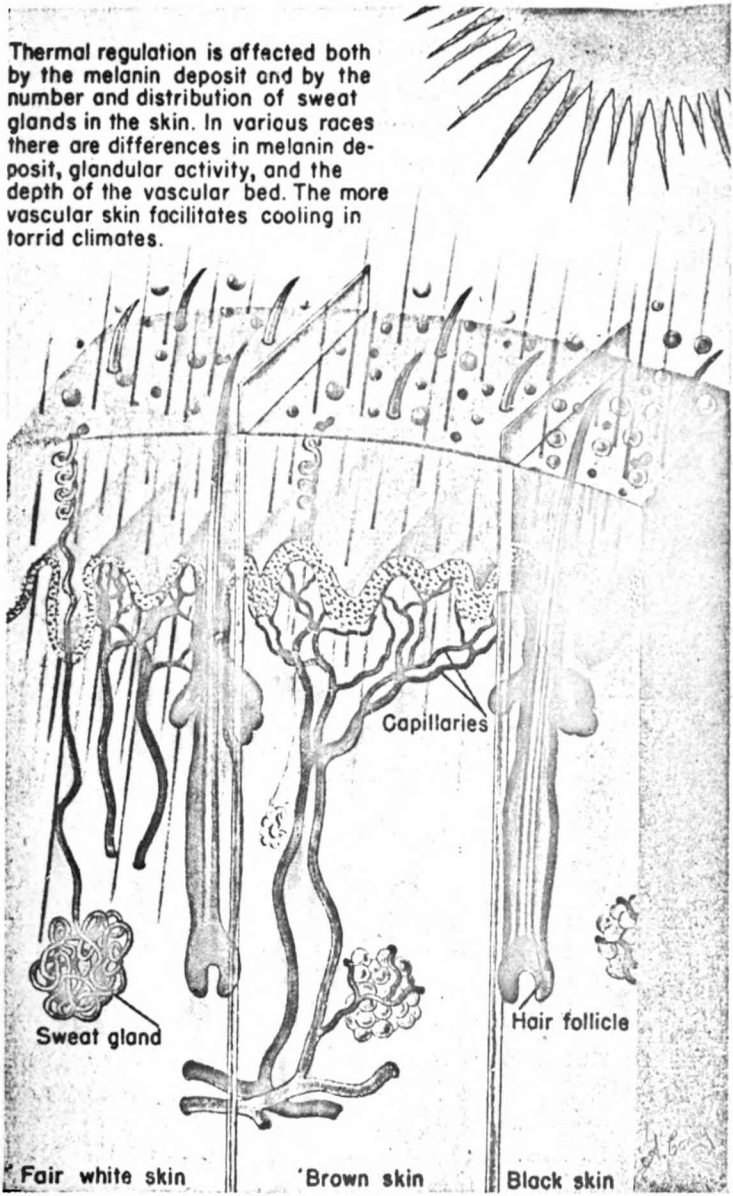
Thermal regulation is affected both by the melanin deposit and by the number and distribution of sweat glands in the skin. In various races there are differences in melanin deposit, glandular activity, and the depth of the vascular bed. The more vascular skin facilitates cooling in torrid climates.
Capillaries
Sweat gland
Hair follicle
Fair white skin
Brown skin
Black skin

Fig. 4. Racial differences in skin pigmentation and ultraviolet penetration.

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100 times as much radiation in the visible spectrum is absorbed, under strong light, by that of a blue-black Senegalese. But the invisible heat rays of the spectrum, the infrared, are absorbed equally by Blacks and Whites alike. On the other hand the lack of pigment in the epidermal layers of the albino's skin or the very slight deposit in that of the fish-belly White, allows the equally invisible ultraviolet rays, from the opposite end of the spectrum, to penetrate deeply. The pigmented layer in the Negro, however, acts as a filter, absorbing and degrading the ultraviolet so that far less of it gets through to the dermis and its vascular system. When it does penetrate, it severely damages the dermal papillae and inhibits subsequent regeneration of epidermis, thus leading to ulceration. Enough penetrates, however, to be used in the production of vitamin D. In the reduced light of our northern cities, the greater susceptibility of Negro children to rickets than in the case of Whites, may be more than a dietary deficiency; physicians working on a clinical hunch feel that it may be due to the absorption of the insufficient (for the Negroes) amount of ultraviolet before it can irradiate the precursor of the vitamin in the epidermal layers. They think that what is good for Timbuktu is bad for Boston.

The distribution of extremely dark-skinned peoples includes African Negroes, Pygmies, such non-Negroid desert and grassland people as the Somalis and Masai, the inhabitants of Southern India, the Andamanese, the Negritos of the Malay Peninsula and Philippines, the whole group of Papuans and Melanesians, the northern coastal and desert people of Australia, and the Negrito fringe of that continent, including the Tasmanians. In the New World, the Indians of Texas, and of Southern California, as well as some of the southwestern Indians such as

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the Papago, approach but do not attain the deep pigment extremes of the Old World peoples. The jungle Indians of Central and South America have yellowish brown skins, no darker than those of Indonesians in Java and Borneo. We know nothing about the optical properties of this type of skin or the type of pigment responsible for it.

Many desert dwellers have black skins. Others do not. The same is true of tropical forest dwellers. The difference may be one of *time*. Those who have black skins cannot be shown to have arrived in their hot places recently. All appear to be geologically old populations in these regions. Those who are lighter skinned, in such regions, are more recent arrivals. Some, like the Tuareg, have been on the desert no longer than 1500 years at the most, or about 50 generations. They swaddle themselves in blue robes, but the equally "White" Bedawin of the Hadhramaut go about in the same sun in breechclouts.

Clearly, then, one does not need a black skin to survive, either in a hot desert or in a tropical forest. If we look at other primates, the same is true. There are black-skinned gorillas in Africa, and both black- and greyish-skinned chimpanzees. Gibbons, whose skin is seldom exposed to the sun, have both black and white hair, and are sometimes piebald. One cannot blame the sun alone for the pigment of Pygmies, Negroes, and Melanesians, at least when they live in the forests.

We have been concentrating on one aspect of skin: its relation to the sun. We have seen that a very dark skin is an effective screen for harmful ultraviolet rays, but that people can get along without it. Skins have other properties. When a black-skinned person is cut, his skin may form keloids—great raised scars—in repairing itself. Most white men's skins do not. It would appear also that the white man's skin may be more susceptible to cancer, to

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which ultraviolet light is regarded as a contributory agent. Under extreme conditions of light, heat and skin-surface chemistry caused by the presence of perspiration, the white man's skin might have an adverse selective value. This is the wildest kind of speculation, and only one of a large number of possibilities. Dermatologists, on the basis of practical observation, claim that Negroes are more resistant to certain skin diseases than some white men.[36] What appears to be a single difference, color, is a mosaic of differences, each with its own value to the individual.

Thus there may be more than one reason for black skins; why people living in hot places over hundreds of generations developed them, and people in cooler, more dimly lighted places, did not. The problem is a complex one. The literature covering it is growing, and experimental work has begun. Much more needs to be done before we can claim to have the answer or answers.

In any case, we know that pigment differences are inheritable. Here again the problem is complex, for several genes working together are responsible for the total pigment potentiality. This is known to be true not only for the skin, but also for the eyes and hair.

CHOCOLATE-COLORED EYE PIGMENT

Anthropologists classify eye color, and by this they mean the color of the outer surface of the iris as seen through the cornea and the aqueous humor, as light, mixed, brown, and black. What they call "brown" seems to be the commonest eye color in man, with a minor incidence of green (mixed) and light. Most of the American Indians, South Australians, Chinese, Hindus, Arabs, North Africans, Siberians, Near Eastern Mediterraneans, and European Mediterraneans, are "brown"-eyed. Sometimes, however, a

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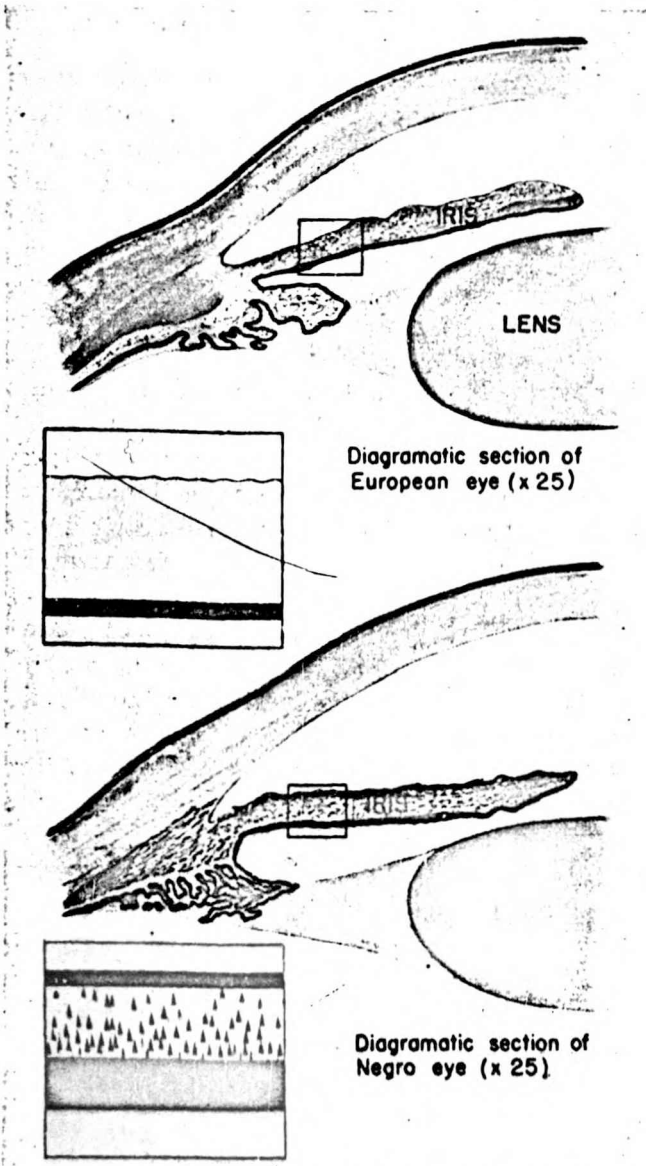

FIG. 5. Pigment differences in the irises of light and dark eyes.

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dense deposit of pigment in the outer layer of the iris produces an eye so dark that it is hard to distinguish the iris from the pupil (Fig. 5). This is a so-called black eye. It is found among the same people who have so-called black skins. Even among the American Indians it has been recorded by a careful observer (Dr. Carl Seltzer) among two desert tribes, Papago and Yaqui.[78] According to Wilmer's data based on a small number of individuals,[89] the heavy pigment of the front of the iris is accompanied in such eyes by a similar deposit in the superficial layer of the fundus. Pigment in the fundus varies from very little, in blue-eyed, fair-skinned North Europeans, through a little more in light-brown-eyed South Europeans and Mongoloids, to a continuous chocolate-colored stratum in Negroes.

The fundus is the central part of the screen on which visual images are cast, and it is these images which we "see." Four conditions are important for accurate vision. The image must be sharp. The amount of visible light let into the eye must fall between a minimum and maximum threshold of intensity. The ultraviolet must be kept below a critical level. There must be no glare created by diffuse light within the visual chamber of the eye.

Sharpness of the image depends on the transparency of the lens and its ability to focus in terms of the distance from lens to retina. The amount of visible light is regulated by the iris, which contracts automatically with an increase in light and dilates as the light diminishes. If the light is too great for the accommodation of the iris, the person usually closes his eyes, turns away, or both. If it is too little, he simply cannot see, and either waits for morning or creates an artificial light.

The lens serves as a filter for ultraviolet, up to a certain level of intensity. More may be injurious. In an albino, whose iris has no pigment, ultraviolet can enter around

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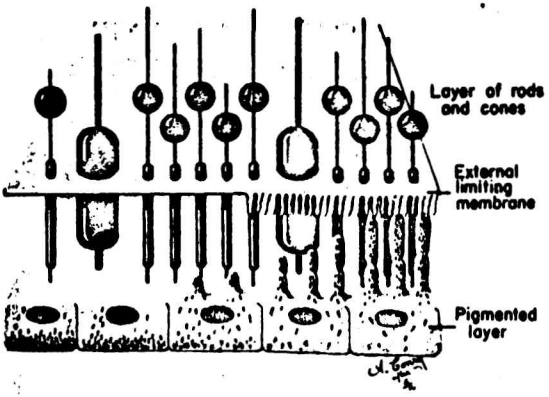

FIG. 6. *The anti-glare mechanism of the retina in deeply pigmented eyes.* In this diagrammatic representation we see five successive stages in the reaction of the pigment cells of a deeply pigmented eye to intense light, moving from left to right. The photosensitive rods and cones are represented as balls and tubes on spindles. When exposed to light, the dark pigment granules rise up within plasma tubes and thus screen the lower portions of the photosensitive cells from glare. (Courtesy, Kahn, F.: Man in Structure and Function. Knopf, New York, 1943, Fig. 392, with permission.)

the pupil as well as through it. It is possible that the chocolate-brown superficial iris pigment of the Negro may be needed in regions of intense light to reinforce the layer on the back of the iris against extra-pupillary ultraviolet penetration. Or it may represent a manifold effect of the genes determining the pigment of the fundus.

The amount of pigment in the fundus varies greatly in man, and these variations provide a wide range of efficiency in resolving (a technical term for seeing distinctly) images in bright sunlight. The lower level of the fundus is composed of pigment cells (Fig. 6). Above it are placed the rods and cones, the photosensitive receptor cells on which the focussed image is cast. Now when a bright light strikes the fundus, the pigment granules in the pigment cells rise to the surface and stretch upward within plasma tubes,

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which surround the bases of the rods and cones and screen them from diffuse reflections, or glare.[46]

An albino has trouble resolving images on a bright day because he lacks pigment not only in the fundus, but also in the iris, and visible light enters through the iris tissue outside the pupil, in addition to that which goes through it. People with light blue eyes seem to have the same difficulty to a lesser extent, owing to the paucity or absence of pigment granules in their pigment cells, although on cloudy days, and a twilight and in moonlight they, and albinos as well, equal their dark-eyed brethren in resolving power.

In general, while it is not correct to say simply that dark-eyed people "see better," we can say that in general they have a higher resolving power under intense illumination, as for example 100,000 foot candles. This resolving power is important for the survival of hunting people who must be able to distinguish game from afar. Over extended periods of time the resolving power of the eye may mean extermination or survival for migrant hunting bands seeking their food on glaring deserts and grasslands, like the Bushmen of today. Hunters who may track a single animal for days before they get within spearshot cannot depend on animals which they come upon by chance; they must spy them from afar. Before the invention of agriculture, the day before yesterday on the human life calendar, good vision was vital.

HELICAL AND SPIRAL HAIR

So far in this section we have been dealing with criteria which show a geographical coincidence with either of two sets of general environmental conditions: (a) high temperature, low humidity, and bright light; or, (b) moderately high temperature, high humidity, and moderate to re-

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duced light. These are the conditions, respectively, of low latitude deserts and tropical rain forests. Despite extreme differences of body size and proportions, the inhabitants of these regions who are believed to be geologically ancient in them hold these surface features in common.

One other surface feature is partially associated with the same geographical spread, and with most of the same ancient populations. This is the kind of hair characteristic of Negroes, Pygmies, and Melanesians, but by no means limited to them; tightly curled helical hair, commonly if incorrectly classified as "frizzly" and "woolly."

Human hair varies in form from straight through wavy to ringlets and deep, tight spirals and curls. Garn[25] distinguishes three basic types of curved hair:

(1) *Wavy hair,* which forms a two-dimensional figure. This varies in the linear distance between the crests of the waves.

(2) *Helical hair,* which forms a three-dimensional figure. Its loops are of a constant diameter as far as each hair is concerned. These diameters vary individually and racially. Helical hair is usually found among Europeans and European-like populations in other continents, and among Melanesians.

(3) *Spiral hair,* which is also three-dimensional. Its loops, however, diminish in diameter outward from the scalp, giving each hair a spring-like or Flemish coil appearance. In its extreme form, the loops are narrow, and intertwine in clusters or rows, leaving patches or swaths of skin bare. This is called "peppercorn" hair.

The great center of spiral hair is Africa. It reaches its tightest, most peppercorn stage among the Bushmen of the Kalahari, whose ancestors and relatives once covered the entire southern third of the continent. The Pygmies of

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the African rain forest too have spiral hair, many with the same extreme peppercorn condition. The hair of Negroes, also spiral, varies in loop diameter, with some approaching the Bushman-Pygmy extreme. Our next move is eastward. In southern Arabia, members of the tribes south of the Ruba'a el Khali desert have both spiral and helical forms, along with straight and wavy. In India, spiral-haired peoples, who also possess other Pygmy or Negro features, live in a few remote parts of the forests in the peninsula. Others have been found in the Andaman Islands, in the forests of the Malay Peninsula, the inmost recesses of Sumatra, and in marginal areas in the Philippines. Beyond Wallace's line, the whole chain of eastern Indonesia and Melanesia contains spiral- and helical-haired peoples; these include Pygmies in the mountains of New Guinea, Melanesians, and Papuans, as far afield as Fiji and New Caledonia. In Australia helical hair seems to be old and marginal, with a partially Pygmy population in the Cairns Rain Forest, and less concentrated along the fringes of south and west Australia. The Tasmanians were helical-haired; they seem to have been formed by the exfiltration of a few marginal Australians over the island chain to the southern island.

So far, the great centers of helical hair are Africa and Melanesia, with islands of spiral-haired Negritos in between. At both ends of the range, minor incidences of these characters have moved northward. In Europe, the oldest, most marginal population, consisting of the Southern Irish, the Welsh, some of the Norwegians and Finns, and the Alpines of Bavaria and adjacent mountain regions, has, like that of Southern Arabia, every kind of hair form, including the helical. As far as we know, however, helical hair in these populations is confined to the head and beard—it does not occur on the body as among Bushmen,

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Pygmies, and Negroes. On the Pacific side, the same hair forms occur among the Okinawans and some of the Japanese. The curly hair of the Ainu, and of some Chukchi and Eskimo, is probably always helical.

The helical hair in Europe has three probable origins:

(1) An invasion of western Europe over Gibraltar by large, square-jawed men from North Africa in Early Post-Glacial times; this would account for its marginal character.

(2) A minor Negroid incidence among Mediterraneans invading southern Europe in Neolithic and later periods after 3,000 B.C.

(3) Occasional mutations to deeply waved and helical hair in Holland, Norway and Ireland.[60, 71]

The evidence for all three of these hypotheses is good. In regard to mutation, similar hair forms have appeared spontaneously in swine, mice, rats, and rabbits.[29, 68] There is no reason why the same should not be true of man, particularly in view of the large number of genes which appear to control hair form.

The early center, or centers, of spiral hair probably lay along a line from West Africa to Melanesia, following the present belt of tropical rain forests of the Old World. There were periods when this belt was probably wider, as for example during the second and third glacial advances in Europe. There may have been a time, before the tectonic movements which ushered in the Middle Pleistocene (second glaciation) when this belt was united by land, although this is far from sure. As we stated before, human beings showing special Pygmy characteristics, and these include tightly spiralled hair, may have spread out across this belt from a single center, or they may have arisen in different parts of it by parallel mutations.

Although the Woodburys[90] observed hair with oval cross-

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sections, which they classified as wavy, among the Navaho, Shoshoni and Hopi, it is not probable that the extreme forms of curvature, helical or spiral, reached the New World before 1492.

All the evidence of geographical distribution suggests that spiral hair is an ancient thing. It has spread farther afield than its companion, black skin. Like the latter, however, it is centered at the heat equator, and this fact suggests that it may have a selective value. Its extreme form, the peppercorn kind of hair, leaves open spaces between the clusters, permitting sweat from the scalp to evaporate. This might be an advantage in a hot, damp forest. The next stage of curliness, a tight mat of short-waved and helical hair, such as one sees in Sudanese Negroes and Melanesians, produces a dead air chamber on top of the head, comparable to a pith helmet, which might have protective value in a desert. No particular advantage can be seen for ringlets or waves over straight hair, nor is any disadvantage visible. One can only say that the whole question of the functional values, if any, of different hair forms is far from clear, that we really know nothing constructive about the subject, and that experimental work on it is badly needed. In fact, we do not even know why some of us have head hair at all. Those who lack it seem to get along well enough without it. In fact, many people who live in hot and bright places shave their heads. The whole subject is still a mystery.

THICKENED TISSUES

Another mystery is the presence of thickened tissues in certain homologous parts of the body in some, but not all, of the deeply pigmented peoples. Negroes and Melanesians have thick lips, often accompanied by large genitalia in the males and large, conical nipples in the females. To

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say that this thickening does not occur in the great apes does not mean that it is an advanced human character; this will be explained in Chapter 7. As far as we know it has no selective value one way or the other. As a criterion of race, however, it qualifies since it is inherited and easily observed. On the basis of the possession of combinations of three characters, deep pigment, spiral hair, and thickened tissues, it is possible to make subclassifications among the so-called Negroid peoples of the world. Only two groups have all three: the African Negro and the Melanesian. Why, we do not know.

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Chapter 5

Surface Variations: Adaptations to Dry Cold

THE SCREENING SCHOOL OF THE COLD

THE coldest spot known in the world today is Verkhoyansk, Siberia, where an official temperature of −96°F. has been recorded. Snag, Yukon territory, Canada, on February 2, 1947, produced a low of −82.6°F. It is too cold for human beings, no matter how warmly dressed, to spend much time out of doors in these places. As even the first U. S. Army tests in the Arctic have shown,[3] −60°F. is as much as an ordinary white man can stand for even a single hour.

Yet there are people who live through cold of this intensity for weeks at a time every winter. They cannot stay indoors all of the time. They must go out to hunt and trap, and in some tribes, to care for their reindeer. The best example of people who live through the world's most intense cold are the Tungus of eastern Siberia, who live in the Amur River country and to the north. Verkhoyansk is in their territory. They have been inhabiting this country as long as we can determine.

The Tungus are members of the Mongoloid race. Some of them are the most extreme Mongoloids in the world. This means that they have not only short, thick-set bodies, as described in Chapter 3, but also flat faces, slitty, fat-lidded eyes, coarse, black hair which is nearly straight, and scanty beard and body hair. The presence of the world's most Mongoloid people at the pole of cold suggests that Mongoloids are adapted to cold, as Immanuel Kant

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suggested in 1775.[47] This possibility will now be explored.

No one could live through a cold winter without efficient clothing and shelter. The Tungus, like other Siberian and American peoples such as the Eskimo, make tailored clothing of furs, and warm houses. Their principal concern is to keep from freezing their faces when out of doors. People who had the same problem first appear on the archeological scene during the last advance of the fourth or Würm glaciation in Europe, when the associated fauna indicate low temperatures. The tool-kits which these people have left behind included fine knives and needles, adequate for tailoring clothes similar to those worn by modern Tungus or Eskimo. Although the archeological remains from Siberia and east-central Asia are so far meagre, there is no reason why other people equally well equipped could not have lived there too.

The center of the last glacial advance which may have reached its peak about 25,000 B.C., was Scandinavia and the Baltic, where the ice sheet was fed by copious loads of moist wind blowing off the Atlantic. A second sheet formed in the Urals. By the time it reached eastern Siberia, however, the wind was drier, and hence glaciers formed only on the higher mountains and on the Arctic islands.[23] The Altai Mountains were glaciated, and so were the Himalayas; Kamchatka, moistened by Pacific winds, bore a heavy sheet. Mongolia, Northern China, and Western Siberia formed a pocket of continental climate, cut into sub-areas by narrow bands of ice. In this wide region the winter temperature regularly went down to the levels which we have mentioned, −80° and −90°F. Any people caught in this series of pockets by the advance of the ice were completely trapped. They had either to adjust themselves to the cold winters, or die off.

We may presume that many of them did the latter. This

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ordeal may have lasted as long as 10,000 years, some 400 to 500 generations, ample time for mutation and selection, or whatever biological processes are involved in evolution. An extremely selective environment, which may have reduced the human population of the enclosed region to a small compass, and isolation could have provided optimum conditions for adaptive changes.[76] These are, indeed, found in other mammals, such as the woolly mammoth.

The people who lived through this cold into a climatic situation like that of today knew how to make the best of local materials, including skins and furs. We must suppose that they were as expert in adapting themselves to their environment as the modern Tungus, Chukchi, and Eskimo. We must grant them double suits of tailored clothing, sewn cleverly of the warmest furs; watertight boots with grass or lichen lining, warm mittens, and fur caps or hoods that protected the head, neck, and ears, leaving exposed only the parts of the face needed for outdoor work, the eyes, nose, and mouth.

The most critical portion of their anatomies was thus the face, from eyebrows to cheekbones to the jaw line and chin (Fig. 2). A man with thin, bony features, especially a narrow, prominent nose, would be in danger of freezing his face. This was probably the most stringent opportunity for environmental selection of anatomical racial characters that has occurred in human history. It is possible that the population of this area was reduced, over a period of half a millennium or more, to a few bands of several families each.

CLIMATIC ENGINEERING—THE MONGOLOID FACE

Out of this climatic circumstance came a type of human being with a flat face, padded with fat, with a sparse

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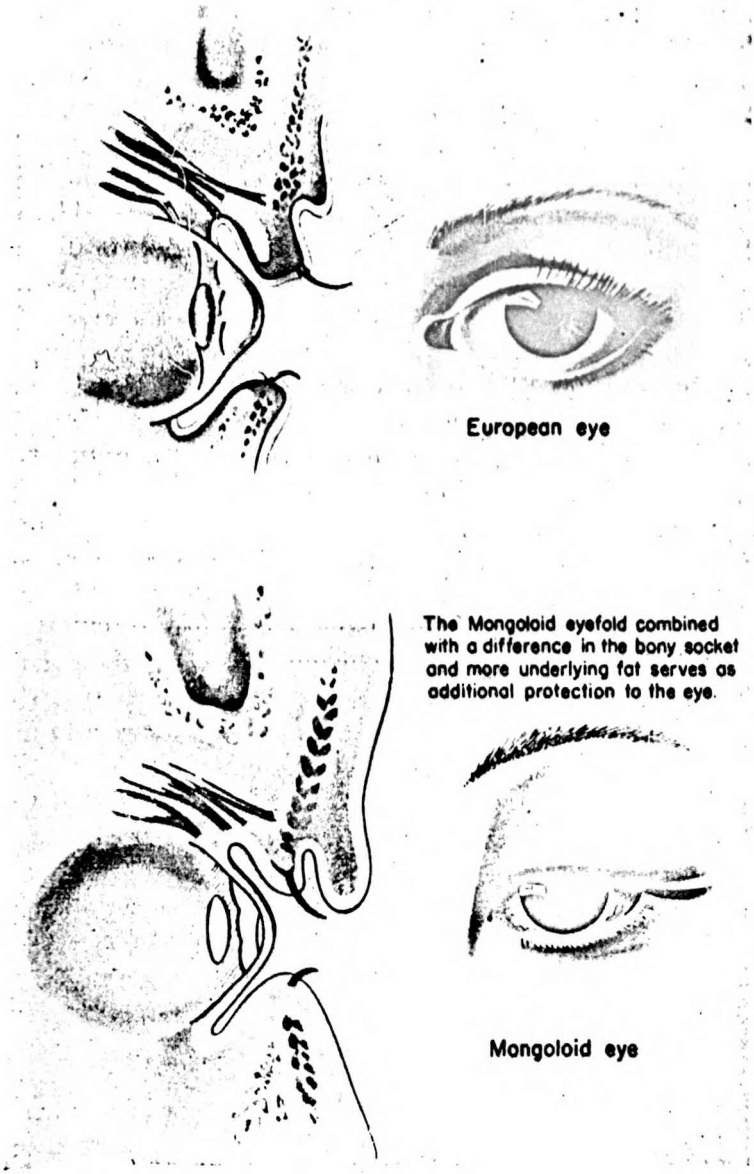
European eye
The Mongoloid eyefold combined with a difference in the bony socket and more underlying fat serves as additional protection to the eye.
Mongoloid eye

FIG. 7. The anatomical basis of the Mongoloid eye.

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beard, and with coarse, black, straight head hair. This is the Mongoloid race in its extreme form, as it is found today in precisely the same region.

Some of its morphological peculiarities may be explained on the easily demonstrated principle that the skull is plastic, in the sense that it adjusts itself to changes in the size, form, and function of the softer organs. The bony orbit of the Mongoloid has been extended vertically, to make room for a heavy fat padding surrounding the eyeball (Fig. 7). Browridges, with their vulnerable sinuses, are reduced. The nasal skeleton is flush with the corneas, and in extreme cases the eyeballs protrude more than the nasal bridge. The mechanism by which this has been produced is simple. In order to reduce the protrusion of the external nose, the malars had to be extended forward and enlarged. The nose could be moved backward a little way, but not far. Although a wide face permitted a lateral compensation in the size of the nasal resonance chamber, needed for speech, the nasal passage system had to remain deep to heat the air taken in. The only other shift possible was for the malars to move forward; this had the selectively advantageous effect of reducing the effective salient of the nose.

As the malars moved forward, so did the eyeballs, for the position of the eyeball and that of the lower border of the orbit are functionally related. In its forward position the eyeball was well protected by fatty layers, padding the lids and bringing their borders close to one another.[88] The slit so formed protects the eyes against snow glare and snow blindness. The Eskimo have invented a wooden slit-goggle to reinforce this. Epicanthic folds offering such protection are also found among some Negroes, especially in the Sudan, and the slitty eye opening of the Bushman has the same

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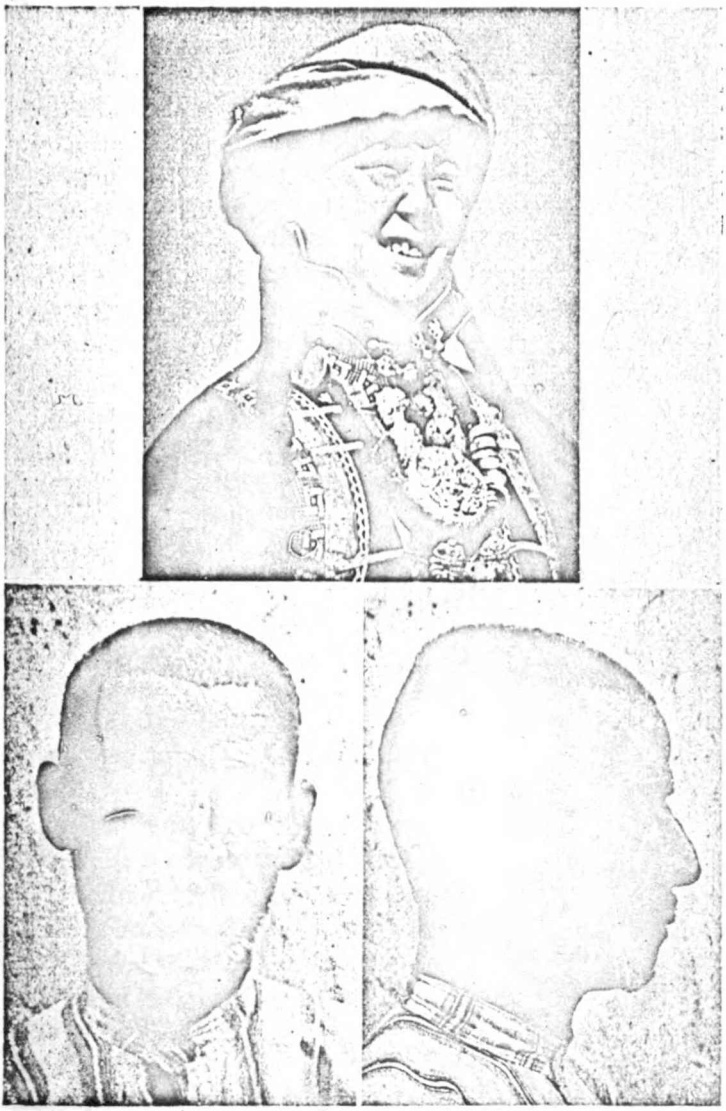

Fig. 8. Face form and resistance to cold. (*upper*) A flat, fat-faced Mongol (Courtesy Pictorial Press, London, and *The Geographical Magazine*). (*lower*) A thin-faced Yemenite Arab (Courtesy Peabody Museum, Harvard).

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effect. Such an anatomical character, useful in deserts as well as in snowfields, must have arisen through a combination of mutations more than once.

Protection against light, however, is only one aspect of the Mongoloid eye. In the far north protection against cold is even more important. Scientists working with the U. S. Air Force during World War II were well aware of the danger which a white man, who lacks this fatty eye shield, runs of freezing his eyes (Fig. 8). With the aid of the General Electric Co. they devised electrically heated lenses for the Polaroid all-purpose flying goggles.

The malars, thus distended, provide a flat surface to the cold; over them are paired fatty pads. The maxillary sinuses are protected likewise. Although the nasal skeleton has been flattened, the nasal passages have not been endangered; in fact, the channels through which the air passes to the lungs are just as long as before, and entirely inside. If an engineer were to sit down with pencil and paper and try to figure out how to make over the face of an undifferentiated human being to meet the world's greatest cold, he could only end up with a blue-print of existing Mongoloid features.

Three principles are involved: (1) reducing the surface area to a minimum, by flattening out as much as possible all protuberances; (2) padding the surface with fat, to prevent loss of body heat, just as in the case of a whale; and, (3) banking up the nasal passages to provide the maximum heat for the air on its way to the lungs.

MONGOLOID HAIR

One other anatomical feature distinguishes Mongoloids; their coarse, straight, deeply pigmented hair. This hair is sparse on the face of Mongoloid men. A Tungus or an Eskimo will have one-fourth to one-eighth as many active

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beard follicles as a European. The diameter of each beard hair will be twice that, on the average, of the corresponding European figure. Thus the volume produced per unit of length will be four times that of a white man. The Eskimo's or Tungus's beard grows one-fourth as rapidly as the white man's beard, and he has to shave only one-fourth as often to keep his face clear of whiskers.*

Keeping the face shaved is vital in the Arctic. Some of the members of the Task Force Musk-Ox grew beards, and the moisture from their breaths froze on the hairs, and soon the faces underneath froze too. Out on a seal hunt, when the hunter is gone from home for days at a time, shaving or even beard plucking is not easy in killing cold weather. Cannot therefore the Mongoloid hair form and beard peculiarities (which seem to be manifold expressions of the same gene or genes) have had a selective value too? Mongoloid hair is not found among the lower primates. Like spiral hair, among the primates as a whole it is a peculiarly human trait.

THE MECHANICS OF CHANGE

How did these changes take place? We do not know. Selection of a rigid degree must have been involved. Shifts of end-organ responses to endocrine stimuli of a permanent, *i.e.*, hereditary, nature have been suggested. Mutations, with a high selective value, would have a good chance to produce a new racial type in a small population over the 400 to 500 generations during which the maximum cold reached its peak. Even the critically low temperatures found at the present may last long enough at a single spell of cold weather to exercise selection. Now that the Government is showing a keen interest in the

* Determined by observation on Chinese students at Harvard. (S. M. G.)

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Arctic and encouraging all kinds of research there, we may soon have more exact information on this subject.

THE COLD LIFTS AND MONGOLOIDS MULTIPLY

When the climate of the boreal zone of the Northern Hemisphere warmed up, the survivors of the cold had every chance to increase in numbers, to fill up their cradle-area, and to spill out beyond its former barriers. The earliest post-glacial populations of which we know in north and central China, Mongolia, and Siberia were Mongoloid. Some of them went across Bering Strait and the Aleutian chain to North America, where unspecialized peoples of the same basic stock had preceded them. Or so all the evidence now at hand would indicate. That evidence is scanty. We may have to scrap this interpretation in another ten years.

During the third millennium B.C. Neolithic farmers immigrated to China from the west, along the oasis route, and through the Dzungarian gates. They tilled the loess in the Kansu, and spread into the Yellow River valley, where they set up the states that were to grow into the Chinese Empire. Many of the aborigines, however, learned to farm also. Some of these were absorbed into the Chinese population, giving the latter its partially Mongoloid character.* Still others were driven ahead of the Chinese, and invaded what are now Indo-China, Siam, and Burma over a period of more than a thousand years, from about 400 B.C. to 800 A.D.

These invasions brought a Mongoloid population into a tropical region. It is believed the invaders moved on out to the island chain, and settled Sumatra, Java, Borneo,

* Wen[88] shows that 29 out of 30 Chinese fetuses had fat lids; the 30th resembled a European.

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and the Philippines, absorbing some of the earlier inhabitants, through mixing with whom they produced the ancestors of the Polynesians, the local Mongoloid variety of which is usually called Indonesian.

In these new areas there was no further need for the flat face, but it remained through a lack of adverse selection. The same is true of the coarse, black hair. The slitty eye with its epicanthic fold became less frequent, and the body grew smaller, the bones finer, the extremities slenderer. Why? Perhaps through selection in responses to the new environment in which heat loss rather than heat conservation was important. Perhaps as a result of the new diet, rice—so different from the blubber and meat of the ancestral Mongoloids. Perhaps through mixture. Perhaps. . . . If only we could settle a few of these problems and afford to stop speculating!

Back on the plains of Mongolia, people led a marginal existence by hunting, grazing a few sheep, and growing a little millet. The population was very sparse. Most people lived around the fringes of the grasslands. Around 500 B.C., however, a great change took place. Nomads from the west rode through the passes in the Altai-Tien-Shan barrier, introducing horses. Now the Mongolian plains are well suited for horse raising, and some of the Mongoloid peoples took to this new life like a duck to water. The population increased, tribe fought tribe for pastures, and confederations of tribes fought the Chinese empire. Before long the Chinese won, and the first of the Mongoloid invaders of the west, the Huns, fled in the only direction possible—westward. From then on Mongoloid peoples were to be seen in Russian Turkestan, and over to the Volga. The grasslands of Central Europe stretched onward without a barrier, and the great stream of Mongoloids, which continued with the Kipchaks, and then the Golden

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Horde of Genghis Khan, began. The rest is European history.

Probably no other racial stock in the world has started with so few and grown to be so many, in such a short span of years. The testing ground of the cold forged a highly resistant, highly adaptable breed of men, and left them ample room to spread in, once the glacial period was over.

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Chapter 6

Surface Variations: Adaptations to Cool, Damp Cloudiness

FOG AND DARKNESS

At the other end of the northern Eurasiatic land mass, in the parts of Europe covered by the maximum of the last glacial advance, we have evidence of another kind of world's extreme in climate, in geologically recent times. While the ice-sheet withdrew, gradually and with much backing and filling, the skies over the landscape it had left were heavy with clouds. There could have been very few bright days in the year. Even today, in the Baltic states, the clouds fill in by October and remain almost without moving until April. In the time of the Homeric poems, about 1100 B.C., we are told that the land of the Cimmerians (immediately north of the Black Sea) was always veiled in fog and darkness. This carries the foggy area farther east and south than it is today.

The amount of cloudiness varied from time to time as the prevailing winds of northwestern Europe blew alternately from the land and from the sea. When they blew off the sea, it was cloudier. It was presumably cloudy by 7800 B.C., before all the ice had melted. From 7800 B.C. to 5600 B.C. was the Boreal period, with winds off the land, cold winters and warm summers, and periods of sunlight. From 5600 to 2250 B.C. was the Atlantic period, warmer in winter, cooler in summer, cloudy, rainy, and foggy.

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From 2500 to 450 B.C. was the Sub-boreal, another continental phase, but still not bright and cloudless, as the Homeric evidence indicates. At 450 B.C. the climate shifted again rapidly, and the moist sea winds blew the fogs back over the land. This climatic phase, the Sub-Atlantic, still obtains today.

The date set for the final disappearance of the Scandinavian ice sheet is 6800 B.C.[64] Before this time there was a secondary sheet in the Urals, which extended south of the present range of those mountains. The presence of this additional center of glaciation may have extended the cloudy region into Siberia in the preceding millennia.

This means that during the last glacial maximum there was an area in which people could live to the east of the ice sheet, and to the west of the center of cold. Later on, after the climate had warmed up considerably, the same conditions appeared again and lasted for over 2000 years. Once more they disappeared, and again returned for a period of equal length.

FAIR SKIN

In the regions in which the above climatic alternations took place, blondness appeared. Three parts of the body are affected by this phenomenon. They are the skin, eyes, and hair. An extremely blond skin deviates from the normal or ordinary light brown human condition by having little granular pigment in the pigmented layers (Fig. 4). A person with a truly blond skin may be incapable of tanning, but simply becomes red and puffy with wind and glare. Such a skin is by no means confined to people living in northwest Europe or their descendants. It may be seen occasionally among albinos in Negro Africa, in Arabia, in Panama, in New Guinea, among

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American Indians, and in fact everywhere. Only in northwestern Europe, however, and in regions settled by people from this region, it is frequent enough to be racial.

In hot bright countries blond skin can be uncomfortable and even painful; it must have an adverse selective value in the tropics. In cool, damp, cloudy regions, the homelands of pale-skinned peoples, it is too cold to go about without clothing during most of the year. Ever since these regions have been inhabited people have worn clothing, especially during the winter when the sun sheds the least light. Clothing greatly reduces the exposed skin area.

How can we explain skin blondism? We may assume that the mutation to blondism reached a higher frequency in the Baltic peoples, and that it remained high because it was not disadvantageous; or, like many physicians, that the production of irradiated ergosterol is facilitated by a light skin. But for the latter assumption we would have to show that dietary sources of vitamin D were at a minimum, and that rickets in childhood is a potent selective factor. While this is not unlikely, it is still to be proved.

Not all persons living in the cloudy area have raw, red skins, and it is doubtful if all ever did. More have pale skins with a little pigment. These people tan in summer, bleach in winter, and get along without trouble in other environments. In such places as Norway and Finland, Poland and Lithuania, there is always a minority of individuals with brownish skins, unaffected by any mutation or selection; it is impossible at this time to tell just when the genes for dark skins were introduced into this region. There probably was never a time when the gene frequency for depigmented skins in this area approached 1.0. If there was a selection for this factor, it cannot have been stringent enough to have eliminated the brunet element.

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BLUE AND GRAY EYES

Blondism in the eye involves an absence of pigment in the outer layer of the iris (Fig. 5). The inner layer is always pigmented except in albinos, and it is this inner pigment shining through the radial and circular muscle tissues that makes the iris look blue. Most light eyes are not pure blue. Diffuse pigment in the outer layers, following the lines of radial and circular muscles, give the effects of raying and zoning; where there is outer layer pigment it is usually concentrated around the pupil, scarcest on the outer periphery. One must be careful in observing eye color to keep the amount of light constant, for the same eye may show one pigment pattern when the pupil is contracted and another when it is dilated. All this means is that the pigmented tissue is adherent to the muscle fibers which constitute the iris diaphragm and move with it. In blue eyes the anterior layer of iris tissue is lacking. Brues has shown that a person can inherit both a gene for pigment in the front layer of the iris, and another for the absence of that layer, with the resulting iris blue.[10]

Perhaps there are circumstances under which a blue eye is better than a brown one, but we do not know what these might be. All we can say at present is that under cloudy conditions a blue eye is not at a disadvantage. Since blue eyes go with florid skins—and this association has been well established—they may have become numerous through genetic linkage to a selectively favorable character.

BLOND HAIR

Two factors at least are involved in hair color, melanin, as in the skin and eye, and a red pigment. The size and number of melanin granules determine hair color, from ash blond to what appears to be black.

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Red-brown pigments may be present or absent, and may be masked by the melanin, or visible, depending on the quantitative relations of the two. From these variations we obtain existing shades of hair. The number of categories one makes is purely subjective; what counts is the quantitative aspects of the two kinds of pigment.

The lightness or darkness of the hair (reflectivity) is due both to the pigment concentration and to the thickness of the hair shaft. In many children the hair gradually darkens as the hair becomes thicker, and the light is thus absorbed by a larger number of melanin particles.

Light hair is not confined to northwestern Europe, nor has this ever been true; in Central Australia whole tribes of natives have been found in which most of the children are blond, but darken later; their skin and eyes seem to be nearly as dark as those of any other aborigine. An occasional "red"* head appears in Southern Australia; the same is true of Mongoloids and of Negritos. All through the Mediterranean racial area blondism seems to be ancient as a minority factor.

BOREAL BLONDISM

While blue eyes and florid skins go together, the pallid white skin, the kind that tans, is more likely to be found among gray- or green-eyed people. In each anatomical region this type has more pigment than the blue-eyed florid-skinned combination. When it comes to hair color, however, associations are less evident.

"Red" hair and brown hair are commonest among the blue-eyed, florid-skinned peoples of northwestern Europe and the British Isles. Ash blond hair is commonest among the pale-skinned, gray-eyed peoples of Central Europe from the Baltic eastward and southward. It is apparent

* "Red" hair is a misnomer; this shade, while strikingly different, is far from spectral red.

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that we are dealing with two different combinations of blondism which may have come from two different sources.

The gray-eyed, ash-blond combination, that of the "white-eyed Finns," is not difficult to account for. Many people with this pigment are stocky, broad-faced, and snub-nosed. They have traveled part way along the road to cold adaptation which the Mongoloids completed. They are the people who came into northern Europe from the east as the ice melted and the land became habitable. Archeologists know what kind of harpoons they made, and museums contain their skulls.

To explain the others is not as easy. Many of the florid, bright-blue-eyed people, as in Ireland and Norway, are large, both tall and heavy. Their heads are large, and their faces likewise. Their upper lips are long, their jaws deep. Their noses are broad and fleshy. Skeletally they resemble in part the Cro-Magnon peoples of the last glacial interstadial, when the climate of western Europe was much as it is today, before the last ice advance. In part they resemble the people who lived in North Africa in early post-glacial times, who, we know from the archeological record, moved northward as far as the Baltic.

People of this second type are not always blond; many are brunet, more are intermediate. They are less frequently blond than the eastern, Finnic type. In North Africa in a few out-of-the-way places people like them remain, and such individuals are sometimes red-haired and green- or blue-eyed. It seems that at least part of this came from North Africa. But how it developed or where these people came from escapes us.

THE NORDIC RACE

A third racial element which has been affected by depigmentation is the Nordic. The Nordics are Mediter-

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raneans* who entered the Eurasiatic grasslands as farmers and herdsmen, possibly from Iran, at some time no earlier than 5000 B.C., when the area bared by the melting of the Ural glaciation was still cloudy. They reached Central and Northwestern Europe during the third millennium B.C. Here they came in at the tail end of the cloudy epoch. They may have obtained the genes for blondism of skin, hair, and eyes in either or both of two ways: by mixing with the aborigines, in the first instance; and by environmental selection, in the second. Actually in all largely Nordic populations two things are true: at least a minority of the population, although morphologically and metrically Nordic, preserves elements of brunet pigmentation; and any sorting between pigmental and other characters shows that extreme blondism and non-Nordic racial characters are associated. The Nordic is only secondarily and partially a blond type.

Since more work has been done on the physical anthropology, archeology, and history of Europe than on that of any other area, we are in a fair position to trace the history of blondism, the most distinctive physical trait or group of traits shown by Europeans. Still, we cannot explain it satisfactorily. It may be that the explanation is very simple, since we have found a tendency to blondism appearing in all peoples who have not acquired black skins and chocolate irides. Blondism may be a frequent mutation in man as a whole. In most regions, however, the environment selects against it and it is kept to a minimum.

It has been observed in Arabia and Morocco, which are bright, sunny places and hot in season, that most of the out-of-door people are brunet except in foggy mountains such as the Rif. Indoor people, however, tend to a higher

* Coon,[18] p. 83.

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incidence of all three kinds of blondism. The typical Fez shopkeeper seldom exposes his skin to the direct rays of the sun, and his eyes rarely meet brilliant sunlight. He spends his life in shaded shops, latticed streets, and protected courtyards. The Yemeni officials of state and religion are also rarely exposed. To say that these people tend to be blond may be a wrong way of approaching the problem; what may be more correct is to suggest that in light-flooded countries people who are blond tend to gravitate into indoor jobs.

Now if a group of people with this usually suppressed tendency to blondism migrated to a foggy place, as Neolithic Mediterraneans did, according to the best archeological evidence, between 5000 and 3000 B.C., the effect would have been the same as if they had all migrated into the shopping district of the nearest Oriental city. They could be blond with impunity. Intermarrying with earlier inhabitants who had also, to a greater extent, become blond, would have served to increase the proportions of observable blondism.

THE DISPERSION OF NORDICS

Just as the Mongoloids spread out from their area of development, so did the blond peoples. In these expansions the Nordic element was at first numerically predominant, because it was the Nordics who knew the more advanced techniques of obtaining food, making tools, etc. As time went on the proportion of older elements increased. These expansions produced the invasion of Greece by Achaeans and Dorians; of Italy by the Italic tribes, from which the Romans arose; of the Balkans by the Illyrians; of many regions by the Celts; and the same by the Germanic peoples. Latest of these expansions was that of the Slavs, which seems not yet to have passed its peak. In the eastern

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part of Europe and over into Turkestan, the original Nordic home, the Scythians and Sarmatians and other horse breeders arose in the first millennium B.C.; before that, even, Iran, Afghanistan, and India were invaded by people of this general type.

In the case of India, one must pause before stating categorically that the Aryan invaders were Nordic in the modern sense. That they were Nordic skeletally and morphologically may be true, but it is doubtful that a high gene frequency of blondism had spread far enough eastward from its area of concentration to make the ancestors of the modern Brahmins very blond. Hence it is not at all unlikely that the narrow-nosed, high-headed Brahmins, as found in Northwest India, with their straight hair, light brown skin, brown eyes, and extreme reluctance to marrying outsiders, do not deviate very far from the physical type of their invading ancestors.

The invasion of India by the Aryans, around 1400 B.C., and the invasions of the Mediterranean regions during the following millennium by Indo-European speaking peoples, had no greater effect on the history of the world than the spread of Northwest Europeans to other continents during the last three centuries. Being located on the sea, the English and Dutch followed the example set by the Spanish and Portuguese. Finding less populous areas, they settled them more thoroughly. The United States, Canada, Australia, New Zealand, and white South Africa owe the bulk of their populations to a combination of these northern peoples, who had received varying frequencies of genes for blondism in different ways. Here again we see an example of a few people, living in an environment much less favorable than others, multiplying at a great rate, once the environmental factors had been alleviated.

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Chapter 7

Race and Evolutionary Status

THE SURVIVAL OF ARCHAIC FORMS AS A PART OF EVOLUTION

IN earlier chapters we have considered some of the mechanics of race formation, including climate, nutrition, isolation, mutation, and selection. These processes, together with crossing at various times and places, have given us the major races which we know today. Race formation is an essential part of evolution, in fact, its first step: when one group has become sufficiently distinct from another group so that the majority of its members are easily identifiable, we call it a *race*. Taxonomists argue about the division of more widely divergent groups into species, genera, and larger categories, which do not concern us here, but on *race* they agree.

Some biologists believe that man is the result of monotypical evolution. This means that the evolutionary process from which man resulted took place only once, and that the various races of living men separated from each other after the human condition had been obtained. Others favor the polytypical theory, by which several primates, evolving in parallel fashion, all became men, and the living races are descended from more than one kind of subhuman primate.* Whichever of these theories may be true, living races have much in common as a result of mixture, which has been going on from the earliest times.

* Gates[21] considers man to be made up of several species, and the product of polytypical evolution. Here the question of division into species is a matter of definition.

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Even among such archaic and isolated peoples as the Australian aborigines, as many as three separate strains have been traced.

One of the basic principles of evolution[76] is that race formation does not proceed as rapidly in some places as in others. Archaic forms may be preserved in one locality, and completely absent in others. That is why it is possible, in an evolutionary sense, to be contemporary with one's ancestors. Ample evidence of the spotty character of evolution may be seen in the large number of archaic forms which persist in all phyla and most genera. Certain insects, ferns, and rushes living today differ little from their Carboniferous ancestors, and a few Devonian-type fishes are still swimming.

Archaic forms continue to exist either because they have always been as adaptable as the conditions have demanded, or because they have been continuously isolated from their natural enemies, as in the case of the marsupials in Australia. The archaic forms of any breed are not necessarily inferior; they are simply older in terms of evolutionary differentiation.

Human beings have had a long history on a large part of the surface of the earth. The earliest human fossils yet found have been extracted from Early or Lower Pleistocene deposits, and already at that time several kinds, or races, of men existed.* Some of them, Swanscombe, Piltdown, and others, were like most living men in a number of essential features; others of them, including Sinanthropus and Pithecanthropus, preserved many infra-human characters, and lived on in the Early and Middle Pleistocene, perhaps as evolutionary dead ends, the less evolved remnants of populations which had developed in earlier times.

* This will be the subject of another *Lecture* in this series.

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From an evolutionary point of view, we assign the Pithecanthropus and Sinanthropus finds to a lower status, because they retain more of the anthropoid characters of the kind attributed to Dryopithecus. He was a widespread Miocene and Pliocene fossil anthropoid whom we have tentatively chosen as base line because he is directly slanted neither toward gorilla nor toward man, but tending toward both. He seems to have stood at or near the fork of the road, between the paths leading to living apes and men. The lower status which we give the Pithecanthropus and Sinanthropus specimens is based entirely on bones and teeth; we know nothing of their soft parts or social habits.

In the middle Pleistocene we find still another group which differs from the Piltdown-Swanscombe group and which preserves certain characteristics which we again call archaic in comparison to Swanscombe and modern man. This is the wide-spread Neanderthal group, which lived in Europe, Asia, and Africa.* Though Neanderthal man showed many archaic characters in his skull, jaw and teeth, he had a most capacious brain. If we judged him on the basis of his skull capacity alone, we would have to say that Neanderthal was advanced, *i.e.*, like us, but the many archaic characters indicate his physical, evolutionary retardation. Again we must be careful of value judgments. We cannot show that Neanderthal was either better or worse than his contemporaries; as far as we can tell he was merely more archaic.

In referring to characters commonly shown by chronologically early hominids, and differing from those of most living men, anthropologists have variously used the terms *archaic, early,* and *primitive.* Since these have also been used in cultural anthropology in a controversial sense,[82]

* Some African anatomists claim that their fossil primitives which resemble Neanderthals are not Neanderthals at all but the product of a local parallel evolution.

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it seems semantically sounder to employ the word *paleanthropic* in reference to the special characters of geologically early (Lower or Middle Pleistocene) men, when exact definition is needed.

In the past some anthropologists have attempted to fit all the known forms of fossil man into a single linear sequence, because it seemed unreasonable to find archaic and modern forms at the same time period. But we now know that this is the rule in evolution. Not all lines go equally far and fast. Not all animal groups are subject to the same selective forces, and probably some lines exhibit a lower mutation rate than others.

Naturally the contemporaneous existence of paleanthropic and modern forms of man did not end with the Pleistocene, though some of the forms mentioned (Sinanthropus, Pithecanthropus, Piltdown) apparently either died out or, like the Tasmanians, were absorbed.

Finds from the Mesolithic and Neolithic in Europe show that forms which we call "modern" because they are preponderant forms today coexisted with forms that preserved more of the characteristics which we call paleanthropic. These Paleolithic survivals[15] existed in out-of-the-way places, where they preserved their racial identities because their isolation protected them from either physical extermination or genetic swamping. Paleolithic survivors are not descendants of the archaic forms found in the lower Paleolithic; they may be remnants of peoples who were then "modern" for their time. To borrow an aphorism from politics, "The radical of today is the conservative of tomorrow."

Applying the same criteria to the various living races of men, to whom some authorities grant subspecific or specific status, we see again that they differ in the number

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of paleanthropic and modern characteristics which they possess. Naturally there is an emotional block against rating contemporary living races, whatever their present level of cultural attainment, and a positive danger that politicians may again confuse anatomical differences with the inheritance of postulated psychological differences. But we have no right to stop working because our material may be dangerous when placed in unskilled hands, any more than atomic physicists should cease their researches for the same reason.

From a biological point of view, this is run-of-the-mill business. We should not be surprised to find races of different evolutionary level existing in 300,000 B.C., or to discover different evolutionary tendencies in races living today. Nor can we ignore the possibility that 300,000 years in the future, men who continue to look like us will be archaic and will coexist with newer forms as yet unknown.

In the past, when evolutionary status was discussed it was often assumed that white Europeans were of the most "advanced" types and therefore were "highest" in evolutionary rank. The fact that the judging was done by white Europeans may have had something to do with the decision. We now know that the peoples collectively assigned to the "Whites" group are really many peoples with diverse racial histories, and that some of them are remarkably archaic. None of the "stocks" of men has a monopoly on either intelligence or physical modernity. But the important point is that some racial groups exhibit, in comparison with others, more of the known characteristics that were commoner at earlier periods in man's history. This gives us a new dimension to use in classifying races. Evolutionary status can be plotted on one axis, and the specializations studied in the earlier chapters, on another.

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COMPARISONS BETWEEN MAN AND OTHER PRIMATES

Ever since the days of Darwin and Huxley people have been making comparisons between human beings of different races, and different genera of apes and monkeys. The theory behind these efforts is that since man and the lower primates are related, and since man has evolved the farther, a study of our backward kin would show us what our ancestors looked like, and which races of living men are physically most primitive or archaic. Most of these comparisons concern the "man-like" apes, or anthropoids.

Man differs from these creatures mostly in limb proportions, in posture, in foot form, in the form and development of the skull and jaws, in his comparative hairlessness and in the shape, size, and use of the brain. To have long legs approximating 50 per cent of total stature is a human character, among the higher primates. So is the specialized non-grasping rigid foot with its dual arches. So too is the upright posture, and greatly modified, bowl-shaped pelvis.

The most marked human peculiarities in the skull and jaws are the height of the vault above the ears, the reduction in the "muzzle" of the jaws and teeth, and the presence of a chin. And of course the brain reaches in man the maximum absolute size among all primates, and the highest size-to-weight ratio among primates of similar size. More important are the characters of the brain which can not be measured anatomically, but lie in the realm of physiological psychology.

Attempts to give living races evolutionary rank on such a basis resulted in confusion. Mongoloids had the most anthropoid leg-to-stature proportions, but were least anthropoid in other characters. Negroes were more anthro-

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poid in prognathism and in pelvis form, but the opposite in other characters, such as spiral hair, thick lips, and large genitalia. Whites usually were more anthropoid in hairiness, in lip thinness, and sometimes in body proportions.

As a result it was deemed impossible to compare living races to various anthropoids, real or hypothetical, for information on the original appearance of man. Lately it has been recognized that many of our important structural modifications must have *preceded* the assumption of the fully hominid status, and that brain and jaw changes probably came last. We now think that walking feet, upright spines, and protuberant buttocks precede premeditating brains, smaller teeth, and mobile lips, along with the capacity for speech. Moreover, we are not yet sure whether man's immediate ancestor was a ground-living ape, a tree-living ape, or an ape at all. Therefore we cannot make comparisons with an unknown form.

CRITERIA OF EVOLUTIONARY STATUS IN HOMINID EVOLUTION

While we are still hunting our infra-hominid ancestors, existing fossil finds have provided us with much information about races which were either ancestral or collateral to our ancestors. The number of finds belonging to paleanthropic hominids now runs into the hundreds. The study of these remains and of other fossil finds less archaic in appearance, has provided us with characters which we can use in assigning tentative evolutionary status to some modern races (Fig. 9).

(1) **Skull thickness**—Uniformly, the early finds, whether morphologically or chronologically archaic, had thick skulls. This is not an ape character. Apes have thin skulls, except for reinforcing ridges. The Javanese Pithecan-

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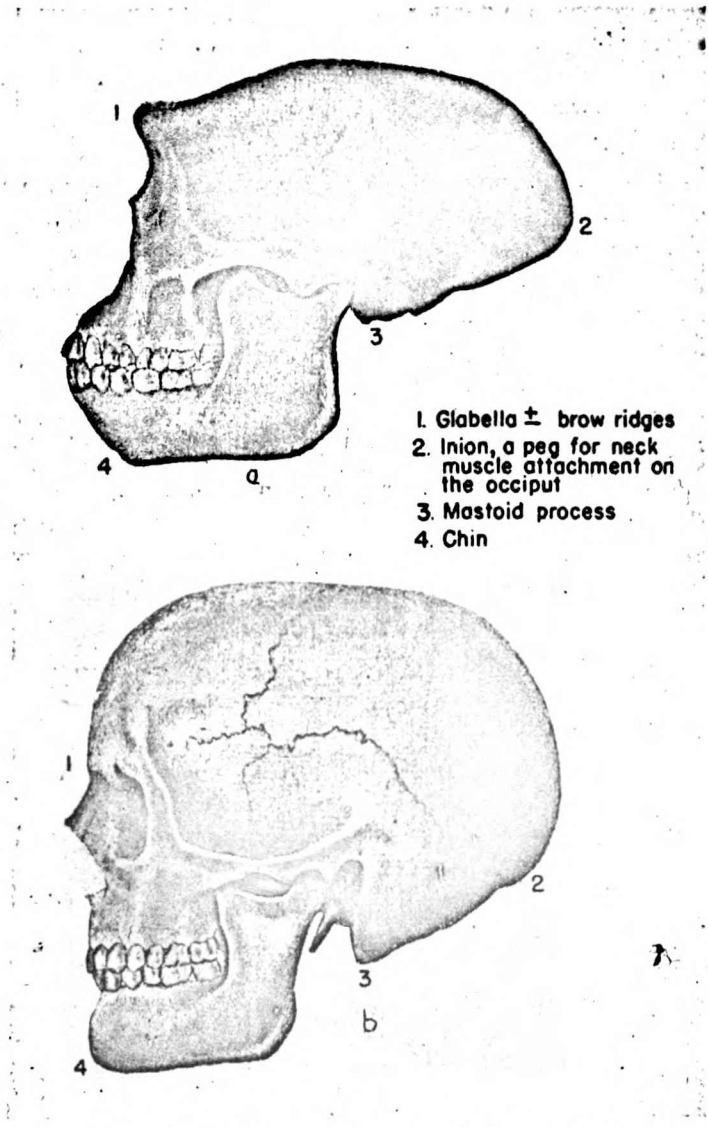

FIG. 9. Critical points in the evolution of the human skull and jaw. (a) *Pithecanthropus robustus* (After Weidenreich, 1945, Plate 4). (b) Modern man (European).

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thropus group, the English Swanscombe-Piltdown group and the Chinese Sinanthropus group were all thick-skulled. Thick skulls apparently ran rampant in the early Pleistocene.

The time sequence seems to bear this out. The earlier Pithecanthropus fossils (if we accept Weidenreich's dating) were thicker-skulled than the later ones. Sinanthropus, who lived later, was less so. In the European theater of fossils, later men had thinner parietal bones than Swanscombe and his contemporaries.

In the Neolithic the gracile Mediterranean brought in not only agriculture but also typically thinner, lighter skulls. (Their leg bones, on the other hand, sometimes exceed early fossil forms in thickness.) Meanwhile, thicker-skulled individuals lived on as hunters and fishers in Northern Europe, and in much of the world. The peoples who attained high civilization in early times, and this includes Mediterranean and Mongoloid peoples, have been thinner-skulled than their more simply living contemporaries. Whether this implies a causal relationship, we do not know.

The same parallels may be drawn in the New World. Finds like the Minnesota woman (early post-glacial Indian) and many disputed "Pleistocene" specimens were relatively thick-skulled, as were recent California and Florida Indians. But the highly civilized (in terms of both technology and complexity of institutions) Peruvians were thin-skulled. Though thick-skulled individuals may not have initiated the more complex cultures of which we know, they have no trouble acclimating themselves to such conditions. The range of skull thickness among members of the New York Stock Exchange and the U. S. Senate probably reaches world proportions.

The important points which we are trying to make are:

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(1) that skulls have shown a thinning influence in more than one hominid line since the early Pleistocene; and, (2) that some kind of association exists between skull thickness and the development of complex cultures. Thick skulls

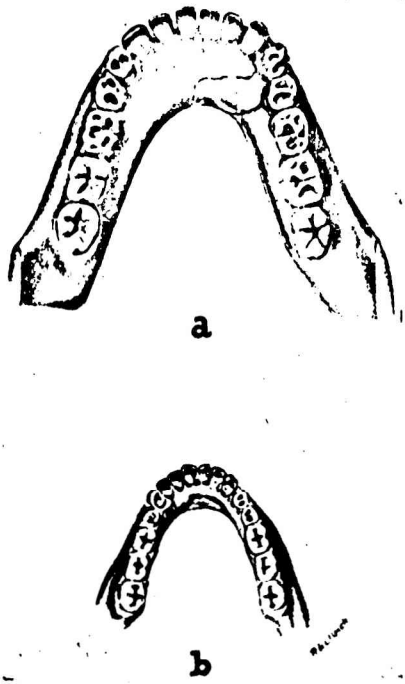

FIG. 10. Evolution in reduction of tooth and jaw size. (a) Mandible of *Meganthropus palaeojavanicus* (After Weidenreich, 1945, Plate 7). (b) Modern man (European).

today, although paleanthropic, have no demonstrable association with degrees of intellectual capacity, nor is there any reason to expect that they should. The seat of the intellect is not the skull, but the brain.

(2) **Teeth**—Tooth size and patterning are also important criteria of evolutionary change or modernization; the present process of tooth reduction has been termed "de-

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generation." "Human" teeth are among those characters that preceded the hominid status; they are present and recognizable in fossil Dryopithecus apes.[35] The teeth of the Meganthropus-Gigantopithecus group,[87] which Weidenreich thinks is ancestral to Pithecanthropus, were not only big—twice as large as those of modern man (Fig. 10)—but they were even more extreme than Dryopithecus teeth in some details of the cusp pattern. Pithecanthropus teeth, with the exception of those in jaw "B," were smaller still. Sinanthropus teeth were even smaller and approached or equalled the famous teeth of the Heidelberg jaw. And the curious teeth of Piltdown, whose association with the skull many challenge, can be provisionally included in the "big" list. Neanderthal teeth were big, but no bigger than those of some contemporary survivors, like Australoids, some Negroids, and some American Indians. But in the majority of cases the teeth of modern men, whatever their special diets and preferences, are smaller still. In addition they often show a reduction in the number of cusps from five (sometimes six) in the lower first molars to four. The third molars have shown a tendency to become impacted or to be missing altogether. Further alterations appearing in the evolutionary sequence include loss of space between teeth (diastema), and a decrease in the thickness of bone in the alveolar region (alveolar covering).

The biggest and cuspiest teeth today also occur among many but not all of the thick-skulled individuals, among the Australians and some of the marginal Whites. The teeth of Mediterraneans, Hindus, Siamese, on the other hand, are frequently smaller and have fewer and smaller cusps. Whether or not these reductions are actually degenerations, and whether they have been accompanied by loss of tooth substance as well as by a simplification of cusp pattern and by size reduction, we do not know.

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The association between tooth reduction and civilization is too well known to stress further here. Whether it has happened through inheritance, through nutrition, or through a combination of both, we do not know, nor do we know why. It is possible to suggest a functional, teleological answer; since we use our teeth less they are getting smaller. But it is unlikely that Pithecanthropus chewed softer foods than Meganthropus. It is not likely that Upper Paleolithic men needed their teeth less than Lower Paleolithic men. And it is not likely that the poi-eating Polynesians give their teeth more work than the grain-eating Egyptians. Tooth-size reduction, tooth-cusp reduction, and tooth-number reduction seem to constitute a trend throughout the time and history of man, with some fossil and living races in the lead. Since, as we shall see, there is a striking relationship between tooth size and jaw size the whole pattern of dental changes may be part of one single complex of change.[24, 38, 87]

(3) Jaws—Jaws are distinct bones with distinct characteristics, linked to tooth size in a general sense only. No one who has seen an Australian's jaw will confuse it with a Lapp's. Even the newest student of anthropology can pick out the Heidelberg jaw in a display. Certain characteristics of jaw size and jaw construction form a nearly unbroken line from monkeys to apes, from anthropoids to man, and from early man to present-day man. These characteristics are useful criteria for our study. Jaw thickness is important. Thick, massive jaws are more characteristic of early Pleistocene man than of any contemporary ape. In general the trend has been to thinner, slighter jaws. But some races have preserved heavier, thicker jaws, along with more massive and more complexly patterned teeth, thicker skulls and other paleanthropic characteristics.

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One peculiarly human jaw development is uniquely interesting; that is the chin—the forward lipping and projection of the lower part of the mandibular symphysis (Fig. 9). Here again some of our more archaic fossil races lack a lipping and forward protrusion, though the "simian shelf" is no longer present. Living races also vary in this character to the same extent that they vary in the other modifications of the tooth-bearing structures.

(4) **Other Paleanthropic Characteristics of the Skull**—In addition to the generally thick character of paleanthropic skulls, whether they belong to the Sinanthropus-Pithecanthropus group or the Swanscombe-Piltdown group, there are other thickenings, reinforcements and crests which indicate that these people had unusual muscles to support their unusual skulls. These thickenings include the ridge on the occipital bone, the buttress-forming, projecting brow ridges, and comparable buttressing tori in the lower jaws. In contemporary races characterized by thick, heavy skulls we find some but not all of these features. In thinner-skulled moderns these tori appear sporadically, rarely as a group. Again we may consider that living races possessing all or most of these bony struts preserve these paleanthropic characteristics. They are earlier in an evolutionary sense.

These thickenings require more than morphological analysis; they require explanation. Sir Arthur Keith once thought that, along with other paleanthropic characteristics, they simply indicated hypersecretion of the anterior pituitary growth hormone.[48] But from what we now know of endocrinology, we can be sure that, in normal individuals, tori are not accompanied by hypersecretion. They are more likely to be expressions of the musculature of the individual, but the existence of any one of them independently of the other suggests that we are dealing with

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independent, genetically-controlled, interrelated conditions of bone and muscle. This in turn would suggest that the presence of these tori in certain living races could indicate a genetic continuity with some paleanthropic fossils of any one of a number of groups. It is unlikely that a hominid form which had lacked these genetic capacities during the Pleistocene would later give rise to forms which regained them.[30] Evolution, we are told, is irreversible.

One of these characters is the supraorbital ridge or torus which lies above the eyes and which, considered as a bilateral pair, is commonly called brow ridges. All paleanthropic forms of importance save Boskop show them, though they differ in size and in the degree of division; and in the Chinese-Javanese finds they are extraordinarily well developed. In modern thick-skulled men, and in some groups of recent American Indians they are well developed. Australians, some Negroids and some European Whites have strongly developed crests. The rest of the contemporary peoples, some of them with equally thick skulls, lack these buttresses.

Another is the occipital torus—a bony protuberance running horizontally along the occipital bone at the back of the head, over the level of the neck muscles. Whatever its function,* it existed in most paleanthropic men, including Swanscombe, and continues today in reduced form among Australians, American Indians, and some Chinese, but rarely in the South African races (Bushman-Hottentot) and recent Europeans.

The third of these characteristics is the mandibular torus, a bony thickening on the inner sides of the lower jaw, likewise situated so as to reinforce the mandible

* Weidenreich[88] thought that it reinforces and buttresses the skull, and may counteract the pull of the heavy neck muscles.

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under the stress of chewing, if this was indeed its function.

Most racial groups may have lost such features in the course of evolution, simply by the concurrent and correlated loss of muscle and bone, and with it the need for additional strengthenings. The lack of such tori in recent American Indians from Peru and other centers of civilization would be an example of the post-Pleistocene loss of skull thickness, musculature, and tori.

Where one paleanthropic character is seen, others usually accompany it. In the majority of contemporary peoples, the whole complex of paleanthropic characteristics is usually, though not always, missing.

(5) **The Brain**—The high point in human evolution lies not in any of the special organs, such as the foot, with its double arch; the hand, with its sensitive fingers capable of countless kinds of fine work; the mouth, capable of speech; or the binocular eyes with their color vision and sensitive macular area. It lies rather in the one organ which coordinates the activities of all the others—the brain. Although unique in its complete form, it grew from simpler beginnings to its present state, adding to the simpler primate pattern the enlarged motor areas controlling hands, tongue, and eyes, and the extended fore-brain, in which the higher neural processes are believed to be centered. Whether the special brain areas grew first, or the greater development of regional musculature, is a chicken-and-egg parable. They had to arise together.

Very little information is available to us on the evolution of the brain within the hominids, because the detailed form of the cerebral hemispheres is only little reflected in the brain case, which is all that we have for evidence with fossil men. To a certain extent the brain gives size and shape to the structures that surround it,

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but brain size is only grossly indicated by the inside of the skull, and even less by the outside. Although extremely careful and excellent research has been done on endocasts, they cannot reveal much of the brain morphology. Cranial capacity exceeds brain volume by about 200 cubic centimeters—because of the presence of the cerebrospinal fluid, which itself varies in quantity, and of the membranes.

Early paleanthropic forms like Sinanthropus and Pithecanthropus had cranial capacities far below those of modern man, and we infer that their functional capacities were far below ours. The other early hominids had brains as big as ours; whether their capacities for behavior were equal to ours we cannot tell. Students of brain anatomy who have examined these skulls have considered the brain convolutions to be of a simpler type than those found among living Europeans.

Brain ability and brain function are dependent upon many factors. The first concerns size, and this is applicable only when related animals of similar body sizes are compared. It is probably valid to compare the brain sizes of the various hominids, but it is not valid to compare the brain of a man to that of a horse, though the brain size is roughly equal. The second factor is anatomical. It is the development of the cerebral hemispheres, and the further specialization within them of motor and sensory centers, with cells of different sizes in the various layers.[82] The third factor has to do with the convolutions of the brain, which increase the surface area of the highly important cerebral cortex and thus provide more surface area relative to the bulk of the brain. A fourth is the growth of association systems connecting different parts of the same cerebral hemisphere, and the commissural system, which connects parts of the two hemispheres. A fifth is the progressive increase in size of the frontal lobe. In these and

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other anatomical factors, one might look for differences between the brains of men of living races, but actually too little inter-racial brain anatomy has been done to warrant generalizations.* Between living and fossil races, only the coarsest of comparisons can be made.

Brain chemistry may be just as subject to evolutionary change as brain anatomy. The mammalian brain, particularly that of man, requires a high metabolic rate. Things that disturb it, whether chemical or circulatory, disturb brain function. The amounts and proportions of certain brain enzymes seem to be connected with this metabolic factor. In one, (carbon anhydrase) man furthers and extends the primate proportions of the enzymes, and finally achieves a new pattern of enzyme distribution.[2]

From these words it may be apparent why differences between races in brain activity and ability cannot yet be determined and why the evolutionary position of the brain has not been studied in living people. That some individuals exceed others in ability is well known, but neurologists do not consider it likely that gross differences in the capacity for "intelligence," however defined, will appear. What they expect to see will be racial differences in specific functional areas, in metabolism, and in the degree of development of the association systems. This, the most important part of evolution, and the one in which the most significant racial differences are likely to appear, has not yet even been tackled.

BRACHYCEPHALY

Wholly apart from the functional anatomy of the brain, is the question of the shape of the skull. The brain is very plastic; a skull can be deformed into fantastic shapes

* Shellshear[16] is one of the few who has considered racial brain anatomy, and he studied only the sulci of a single individual.

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without discernible injury. Some peoples habitually deform their babies' heads with boards, straps, and bandages. Among early fossil types, the brain was small in relation to teeth and jaws, and the shape of the skull depended partly on its function as a hitching post for the jaw and neck muscles. It was relatively long and flat. As the brain grew the jaws remained constant or shrank; the need for muscle attachment was less, and the bulge of the brain case provided the necessary leverage. The shape of the skull came to depend on the shape of its contents rather than on its mechanical duties. During the Late Pleistocene, some skulls were brachycranial, i.e., rounder than others; in more recent times round skulls have appeared independently in different populations in various parts of the world, and their proportions have increased. Roundheadedness seems to be linked to nothing else in particular, and it has no discernible functional advantage. However, since it is a progressive, and relatively new thing, some authors believe it to be part of the evolutionary scheme.[86] Despite its functional and evolutionary ambiguity and its general unimportance, it is the most measured of all criteria. We know in detail the cephalic indices of most of the people of the world, including many altered by cradling. As a racial criterion it deserves mention principally because we would have to explain were we to omit it.

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Chapter 8

Race and the Invisible World

DISEASE—ITS SPREAD AND OUR CAPACITY FOR RESISTANCE

PHYSICAL and cultural evolution in man are not, as we have seen, unrelated subjects. As Gordon Childe said, *Man makes himself.* This statement needs, however, some qualification. We have not arrived at the age of test-tube babies, or Aldous Huxley's Alphas and Betas. We shape our own ends in ways that we neither plan nor expect. The vast majority of genes in the human chromosomes control the capacities of the organism for actions and reactions which are just as invisible as the genes themselves. Many of these actions and reactions concern another invisible realm, that of microorganisms and viruses, the existence of which human beings did not even suspect until the middle of the last century. Human beings by their varied manners of living create environments which are to different degrees hospitable to these organisms, some of which exercise a far more stringent selection on human beings than the rays of the sun, the temperature, the altitude, or the need for grinding food. These are organisms which produce lethal or crippling diseases.

The spread of many diseases depends on three factors —the amount of contact between individuals, the efficiency of their hygienic methods, and their general physiological resistance to disease. In any population, the chance of contagion is a linear function of the number of interpersonal contacts, and this in turn depends on a combination of environment and technology. People who live on

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deserts without domestic animals have to walk over large areas each day to find their food, and no more than a few dozen can camp together during most of the year. Grassland hunters and gatherers can form bands of fifty to a hundred, and peoples who live in the most favored environments—the Mediterranean and temperate maritime climates—can form villages of a hundred or more. Under ordinary circumstances food-gathering peoples come into physical contact with no more than a few hundreds of others during their lifetimes. They have a minimum of opportunity to spread diseases. During 99/100 of the life history of man, this has been true.

CIVILIZATION AND SANITATION

Around 5000-6000 B.C. in Iraq and Iran, and in Egypt, people began to cultivate plants and breed domestic animals. The Neolithic type of civilization resulted. This meant larger villages, more time spent at home, more trade, and eventually a dense agricultural population which had to spread. The chance for diseases to spread also increased. Around 3000 B.C. village life grew into city life in the valleys of the Tigris-Euphrates, Nile, and Indus. Walled cities, narrow streets, crowded bazaars, temples, baths, and houses of prostitution brought the amount of physical contact to a maximum, comparable to what one finds in Oriental cities, like Fez, Cairo, Calcutta, and Canton today. The spread of disease became so great an enemy that these cities characteristically were unable to maintain their population level and had to be fed by immigration from the healthier countryside. In the city specialization, a fine division of labor, arose; a householder would go to one shop for meat, another for honey, a third for bread, a fourth for candles, and so on; this divi-

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sion of labor increased the chances of contagion. Disease, a minor factor in the life of an open-air, simple food-gatherer, became probably the most important selective factor of all in the life of the Oriental city dweller.

We must not forget that celibacy too plays a part in keeping down urban populations. With extreme specialization, a young man needs a long time to learn his trade, and can seldom afford to support a family until he has mastered it. A wife and children must be fed from the shops, and not off the land; also, they can do little to help earn their keep. Further, with coffee shops, baths, and brothels the young bachelor can find more amusement in the city than in the village.

Added to this we must remember that almost no advances were made in hygiene from the beginning of time to the Nineteenth Century. Primitive food-gatherers urinate and defecate outside the camp, and by the time that this refuse has become a health menace they have usually moved on. Villagers usually go to stool in their gardens, where the refuse serves as fertilizer. It also often contaminates the water supply, producing dysentery and other diseases, some of which are lethal. In Egypt it produces bilharzia, a hookworm-like disease, which has kept the population down for millennia.[6]

In general, the open-air camp is far healthier than the village when it comes to contagion, and the small group far safer than the large one. In the far north, however, and in other places where winter cold is critical, even a small group may be at a disadvantage, owing to the way these people crowd together to keep warm. The fetid fur boxes of the Chukchi, and the semi-subterranean communal house employed by Asiatics and American Indians all the way around the Arctic, are traps of contagion once a new

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disease sets in. During the winter whole villages can be nearly wiped out in a few weeks. In this climate disease joins the cold as a genetic screening sieve.

Even more critical is the lack of hygiene in Oriental cities. In a few, such as Fez, water flows under privy seats and carries the refuse away; in others refuse accumulates in pits and has to be carried away once every few months or years. In others, as in Southern Arabia, it is flushed into a heap alongside the outer wall of the house, and in still others it is dumped into the streets from chamber-pots out of balcony windows, as was the custom in Medieval Europe.

Except for modern cities in Western Europe, America, Australia, and a few other places, hygiene is a negligible factor. Human beings who live in old-fashioned cities have to be selected for resistance to contagious diseases. Measles, mumps, German measles, chicken pox, etc., are now diseases of childhood, and not very serious, but they have killed off large percentages of populations living under simpler cultural conditions after their introduction by white men. Without much question these were once dangerous adult epidemics in the Old World urban civilizations. History is full of documents regarding the Black Death, the Great Plague of London, and other such visitations. These epidemics, which reduced whole populations to less than half their former sizes, must have selected people rigorously for their capacity for resistance.

The epidemics spread by the arrival of white men, which carried off the majority of the population among many American Indian tribes,[78] islands of Polynesians, etc., selected these peoples for one class of disease at a time; however, in Oriental and Medieval cities the people were exposed to several at once, since all were endemic.

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SELECTION FOR RESISTANCE

The human capacity to resist diseases, although primarily physiological, may also favor certain anatomical characters. The efficiency of the circulatory system under malnutrition, the resistance of liver and kidneys to local infections, etc., might be greater in small people than in large ones, and in slender rather than in thick-set ones. Such conventional racial characters as skin color, hair form, and facial configuration would remain unaffected since they probably have no connection with disease resistance.

Another set of factors might select for growth and maturation. Resistance to infection is least during two periods of life: childhood and old age. Only the former is of importance for group survival. Sex hormones, as we now know, have much to do with immunization and resistance to disease. Since the chance of infection is a function of the duration of exposure, slowly maturing individuals would be relatively more vulnerable for a longer time than those who come to sexual maturity at an earlier age. Thus, over the course of years, the slowly maturing, lanky, poorly coordinated adolescents so commonly seen in our antiseptic society would tend to be pruned out through natural selection during the critical periods of childhood, if they lived under unfavorable conditions of nutrition and sanitation, as in an Oriental city.

Until the period of exploration and conquest which began in the Fifteenth Century, the world was wide and travel difficult. Whole populations were able to live in separate geographical compartments, and only occasionally did a stray traveler bring in new diseases. Oriental cities could fester in their own germ cultures, and primitives hunt in health. Until the Twentieth Century travel in-

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creased, and so did chances of infection, but so did medical knowledge. By rigid barriers of inspection and inoculation Europeans and Americans were able to protect themselves from the diseases of China and India, while in turn infecting the peoples even more vulnerable than themselves.

DISEASE SELECTION AND PHYSIQUE

It is our impression that the pre-hygienic urban populations of the world, of the Near East, the Mediterranean, of the Inca and Aztec cities, are shorter, lighter, thinner-boned, and narrower-faced than their country cousins, and they exhibit more asymetries of body and face as well. With thinner faces, they also tend to have narrower noses.

Part of this urban size inferiority has been attributed to selective migration, on the theory that the big, heavy man stays on the farm. More, however, may be attributed to the selective action of diseases on the assumption made by many medical authorities that the small, compact man has an advantage in this respect over his bigger and lankier relative. Some of it may also be the result of the special city diet which has accompanied urbanization everywhere. In the city, food is the most expensive part of the budget; food is not grown in cities, and carries with it the costs of production, distribution and retailing.

City food is largely ground and processed cereal food; only the farmers and the rich people can enjoy much greens and meats. The effect of low-protein low-amino-acid diets has already been mentioned. We know that adequate supplies of these dietary essentials will produce experimental animals with twice the weight of those raised on simple, flour diets.[1,65] This experiment has long been in process in man, and the smaller size of grain-fed city people parallels the feeding experiments of the modern

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nutritionists. Two common ailments of civilized man, dental caries and malocclusion, began in cities and there reach their most unesthetic extremes.

Urban people, whatever their other racial characters, tend to have short arms and small, delicate hands. The fingers need to be maneuverable, capable of fine and skilled actions, and need not be very strong. There is nothing in an Oriental city which takes a great outlay of muscular energy at one time, in one thrust;* there is much, however, that requires endurance. This business of the size of the extremities, like that of the jaws, requires much more study. We do not yet know to what extent the size and shape of the extremities of the individual are altered by use, how much of this easily recognizable urban physique is phenotype and how much genotype.

Modern European and American cities are quite different in their effects on the phenotype from those just considered. Most of us are no more than two or three generations from the country, and these generations have been lived under relatively sanitary conditions. We have been shielded from disease, and we have been deliberately fed foods which give the organism every chance to approximate its maximum genetic capacities. We are "primitives" who have escaped the disease selection of India, China, Egypt, by historical accident.

It is our thesis, and no evidence exists to the contrary, that the small-jawed, fine-boned, Mediterranean facial types in the Old World, and their beaky American Indian counterparts in the New, arose with and in response to the living conditions imposed by a food-producing economy, and reached its final definition, in its extreme forms, in cities.

* An exception: Porters—these are usually recruited from outside. In Baghdad, for example, they are mostly Kurds.

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Chapter 9

The Races of the World

THE BASIS OF CLASSIFICATION

NOW that we have some idea of how races may be formed, let us look at the results. Our next job is classification, or *taxonomy*. Botanists and zoologists collect leaves, flowers, moths, the skins and skeletons of animals, and try to place these specimens into an orderly scheme based on the system of Linnaeus and his followers. Using such criteria as shape and notching of leaves, number and shape of teeth, the structure of foot bones, the color of fur, etc. they sort their specimens into phyla, orders, genera, species, and races. Experimental biologists interested in both plants and animals try to work out the genetic basis for these similarities and differences.

In studying living men we are concerned with but one species, *Homo sapiens*. Our task is to classify those races, produced by the forces outlined in the previous chapters, which have survived until the present day. Our basis of classification must be the same as that employed with other species of plants and animals.

RACE IS PHENOTYPE

The zoologists and botanists handling their pressed leaves and cleaned bones are basing their classifications on phenotypes—on the net end results of the forces of heredity and environment working together. The laboratory man who plants maize in pots and his companion who breeds fruit flies or mice are trying to discover genotypes as well. In attempting to classify human races we are obliged by

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the nature of the evidence and by our means of interpreting it to rely almost entirely on the former method. We are dealing with the whole man, in his adult form. We do not know how much of what we see and describe is inherited, and we may never know.

NO FAMILY TREE

To determine genetic relationships between groups of people we need more than descriptions of their present forms; we need historical evidence in the form of skeletons, sculpture, paintings, etc. For few lines of man is such evidence available. We are not yet in a position to draft a family tree for all, or even most, of man.

RACE IS POPULATION

When a botanist or zoologist publishes a description of a new variety of violets, moths, or skunks, he depicts not an individual plant or animal but a composite, a type specimen, the mean of the group. He may also mention the range of variation reached by individual specimens in certain criteria, as for example in the width of the white stripe on the skunk's back.

The experimental biologist may define his variety or race of mice or fruit flies in terms of the percentile frequency of certain genes which he has succeeded in isolating. He knows that all members of a race are not genetically identical. Each race contains a normal variability in genes. In man, one would not say that two brothers who looked alike were of different races because one belonged to blood group A and the other to B.

A race therefore is in a sense a *population*. A population is composed of individuals who normally interbreed, possess a common genetic pool, and look alike within broad limits. This population can be described by the usual

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statistical methods which biologists employ: the determination of means, standard deviations, standard errors, percentages, and the like. By the same means different populations can be compared and their phenotypical identities or differences determined.

In the partial and tentative list of races which concludes this chapter we have kept this principle in mind: *a race is a population which differs phenotypically from all others with which it has been compared.* These differences are of varying degree. If we know of genotypical differences as well, we can add these to the list.

Such a population may consist of a few hundreds of individuals or of several hundreds of millions. It may occupy a single geographically unified area, or be scattered over many widely separated regions. Its members may speak one or many languages, worship one or different gods, and be the citizens of one or many countries. Language, religion, and nationality are all elements of human behavior, not associated with race in any direct or immediate cause-and-effect way.

RACIAL TYPES

Races are formed by the dual process of variation and amalgamation. Variation can arise through mutation, or through the introduction of new genes by outbreeding. In this sense all races are composite. Out of a class of boys of old New England ancestry an anthropologist may select one student whom he can call Mediterranean, while he labels another Nordic. Both students may be descended from the same small group of immigrants who entered New England eleven generations ago, and who may themselves have varied in much the same way. Each student may have had ancestors who resembled each other. The two may have had many common ancestors. The terms

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Nordic and Mediterranean when so used refer not to whole races, but to types.

Often what is a type in one population is a race elsewhere. Some local populations in the Scandinavian countries meet the common specifications of the term Nordic. Others in Southern Europe, North Africa, and Southwestern Asia are Mediterranean. Some types, however, have no living racial counterparts. One can pick out among the Irish and Scandinavians individuals who fit all the specifications of Cro-Magnon man as we know them, but as far as we know no population composed entirely of such persons exists today. In our list of races, certain entries appear most frequently as racial types—in such cases this is so stated.

A BROADER CLASSIFICATION—RACIAL STOCKS

Most textbooks which deal with race classify mankind into anywhere from three to seven major groups, often called *stocks*. The bases of classification usually include skin color, hair form, and nose form, and are further governed by geography and history where the last is known. Most writers admit the existence of three major stocks, whose members include the vast majority of mankind: the *Negroid, Mongoloid,* and *White* (also called *Europoid* and *Caucasoid*).

The Negroid is usually made to include the heavily pigmented and spiral-haired peoples of Africa, the Negritos or Pygmies wherever found, and the Melanesians. The Mongoloid designates the relatively flat-faced, coarse-haired, straight-haired peoples of Eastern Asia and Indonesia. Some authors include the American Indians in this class. The Whites are recognized as the Europeans and the non-Negroid, non-Mongoloid peoples of North Africa

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and Western Asia, as well as overseas representatives of the same.

Anthropologists concerned with evolutionary and culturo-historical problems more than with sweeping categorizations usually recognize another stock, the Australoid, in which they place, besides the Australian aborigines, some of the peoples of Southern Asia and its island fringe. The discriminating classifier usually adds two more stocks: American Indian and Polynesian, recognizing that the former bears resemblances to both Mongoloids and Whites, while the latter is some kind of a mixture of Mongoloid with other elements acquired in Indonesia or Southeast Asia somewhere about the time of Christ.

We now have six putative stocks, as follows: Negroid, Mongoloid, White, Australoid, American Indian, Polynesian. To the educated citizen who has not studied physical anthropology, this taxonomy may appear adequate. To us these groupings mean the following:

(1) *Negroid:* all peoples showing special adaptation to bright light and intense heat, wherever found.
(2) *Mongoloid:* the same for adaptation to intense cold.
(3) *White:* Peoples of the Old World, excluding Australia and the southeastern fringe of Asia, who possess neither of these two kinds of adaptation. Overseas settlers of the same origin, and similar phenotypical form.
(4) *Australoid:* The native inhabitants of Australia, whom one of us (Birdsell) has shown to belong to two distinct races and to include one other type. Veddas of Ceylon, and possibly some other remnant populations in Malaysia.
(5) *American Indian:* The descendants of the pre-Columbian inhabitants of North, Central, and South America.
(6) *Polynesian:* The inhabitants of the outer islands of the Pacific, from New Zealand to Hawaii to Easter Island. While moderately variable, they show resemblances to Mongoloids, Whites, Australoids, and possibly Negroids.

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The names of these "stocks" serve as a convenient set of labels which we all employ, useful as long as the student realizes that they are generalized, arbitrary, tentative, and in some respects misleading. They suffer from the faults of oversimplification, and from the implication of genetic relationship. The student should remember that a stock is not a race, but merely a convenience in classification; it is a lumping of races which seem similar to each other into broad categories. Nor is a type a race. Our definition of race given earlier may be reduced to this—*a race is a somatically unique population or collection of identical populations.* In the tentative list which follows we have tried to follow this definition, but warn the reader that some of the races described may fall closer to the concept of *stock* and others to that of *type.* The taxonomy of man is far from being completed.

THE PRESENT CLASSIFICATION

The following tentative list (Fig. 11) is based on the position of each group on three scales, derived from the preceding chapters of this *Lecture:* (1) *Evolutionary status,* as reflected in differences in tooth and jaw size, skull thickness, brow-ridge size, and the presence or absence of other archaic features. A number of races show considerable internal variability on this scale. (2) *Body build,* as reflecting special adaptations to deserts, mountains, heat, cold. (3) *Special surface features,* such as black skin, flat faces, etc., which appear to be adaptations to heat, light, and cold. This might be called a functional classification.

1. Murrayian—Nearly extinct aboriginal population of S.E. Australia (Plate 1). Stocky build, brown skin, wavy hair, abundant beard and body hair, facial features similar to broader-faced Europeans. High frequency of palean-thropic features including heavy brow ridges, large teeth, and thick skull.

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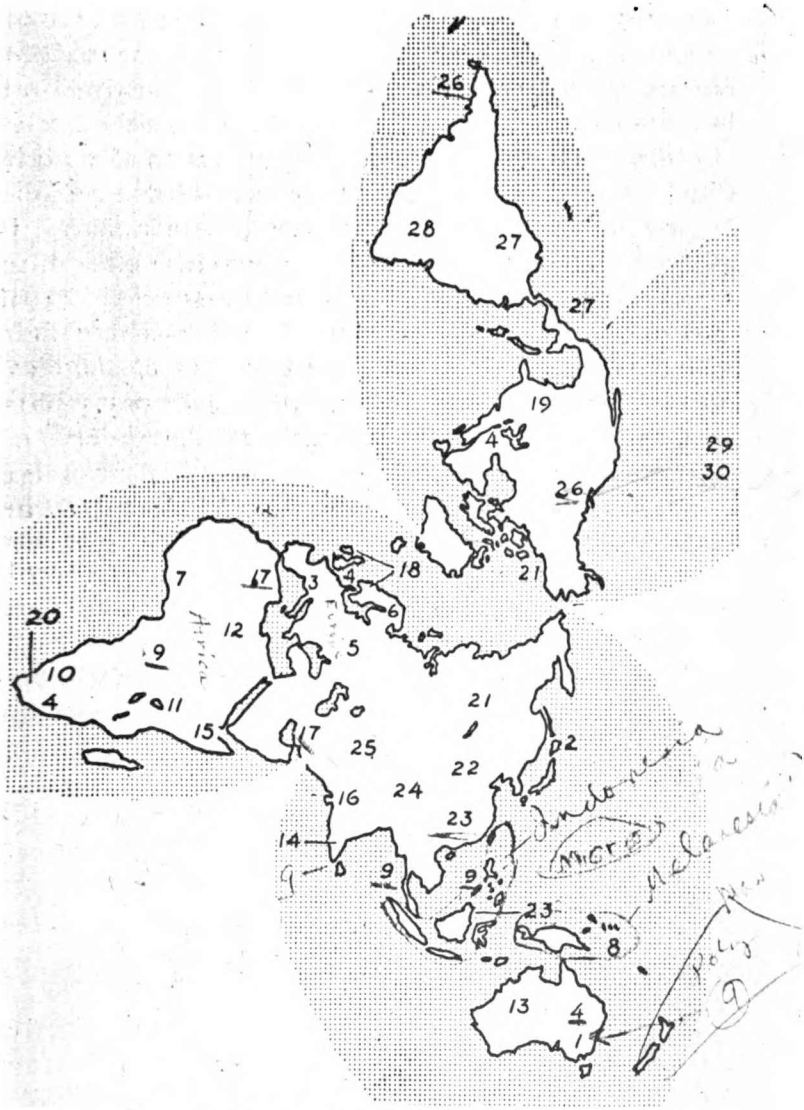

Fig. 11. Distribution of tentative racial types.

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2. **Ainu**—The aboriginal population of Japan, now limited to Yezo and one of Kuriles (Plate 1). Similar to Murrayians but with lighter skin. Usually included in White stock.

3. **Alpine**—Europe is one of the few regions where we know something about racial history, upon which we can call for aid. Before 3000 B.C., it was inhabited by food-gatherers many of whom resembled Murrayians and Ainu, at least skeletally. Mediterraneans and Nordics, both farmers and herdsmen, invaded from the East; the former along the shores of the sea for which they are named, the latter north of the Alpine mountain barrier. European peoples of today result largely from the blend of these earlier and later populations, subject to selective factors and other changes. The peoples of Central Europe and adjacent parts of Western Asia, who live along the mountains from France to Tajikistan, are one of the products of this blend. They are usually called Alpine (Plate 2). Alpine is a type, of medium stature, thick-set body build with short arms and legs and large hands and feet, broad head and face, straight to wavy hair, abundant on

1. Murrayian
2. Ainu
3. Alpine
4. N.W. European
4a. N.W. European Prototype
5. N.E. European
6. Lapp
7. Forest Negro
8. Melanesian
9. Negrito
10. Bushman
11. Bantu
12. Sudanese
13. Carpentarian
14. Dravidian
15. Hamite
16. Hindu
17. Mediterranean
18. Nordic
19. N. American Colored
20. S. African Colored
21. Classic Mongoloid
22. N. Chinese
23. S. E. Asiatic
24. Tibeto-Indonesian Mongoloid
25. Turkic
26. Am. Indian Marginal
27. Am. Indian Central
28. Ladino
29. Polynesian
30. Neo-Hawaiian

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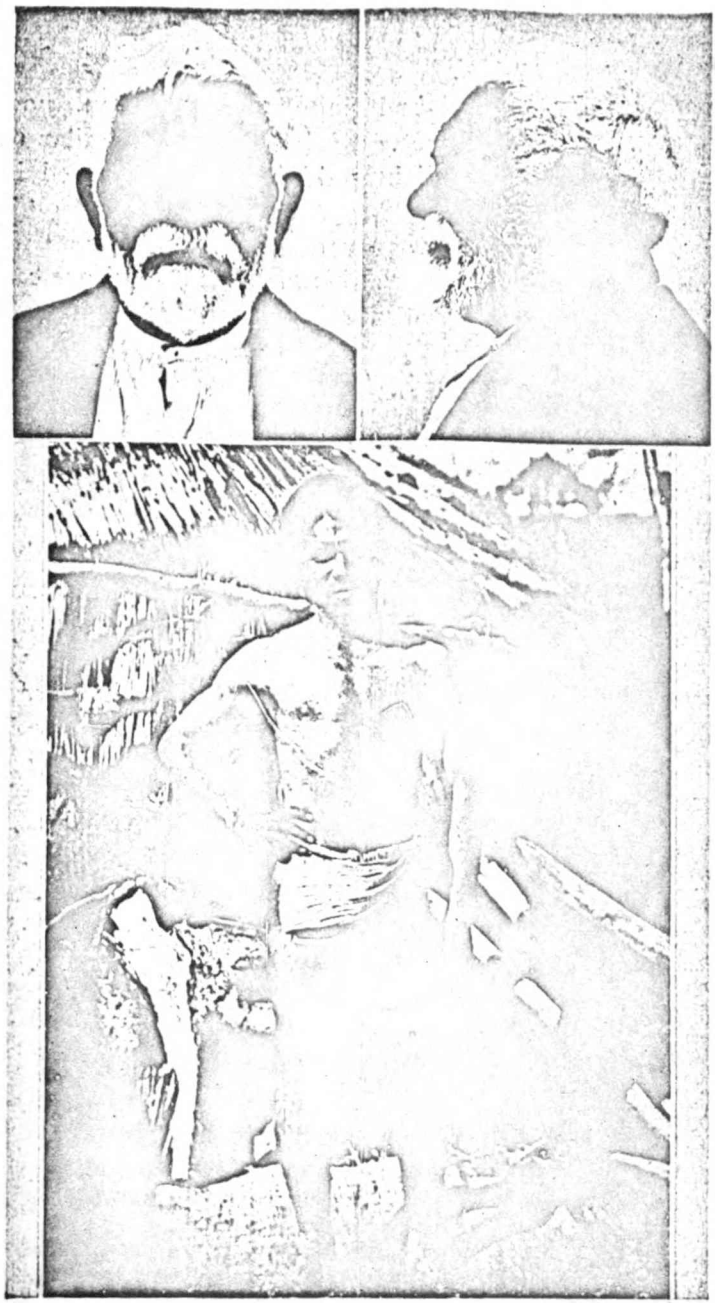

PLATE 1. ***Upper:*** **Race No. 1: Murrayian. (Courtesy Peabody Museum, Harvard)**
Lower: **Race No. 2: Ainu. (Courtesy The University Museum, Philadelphia)**

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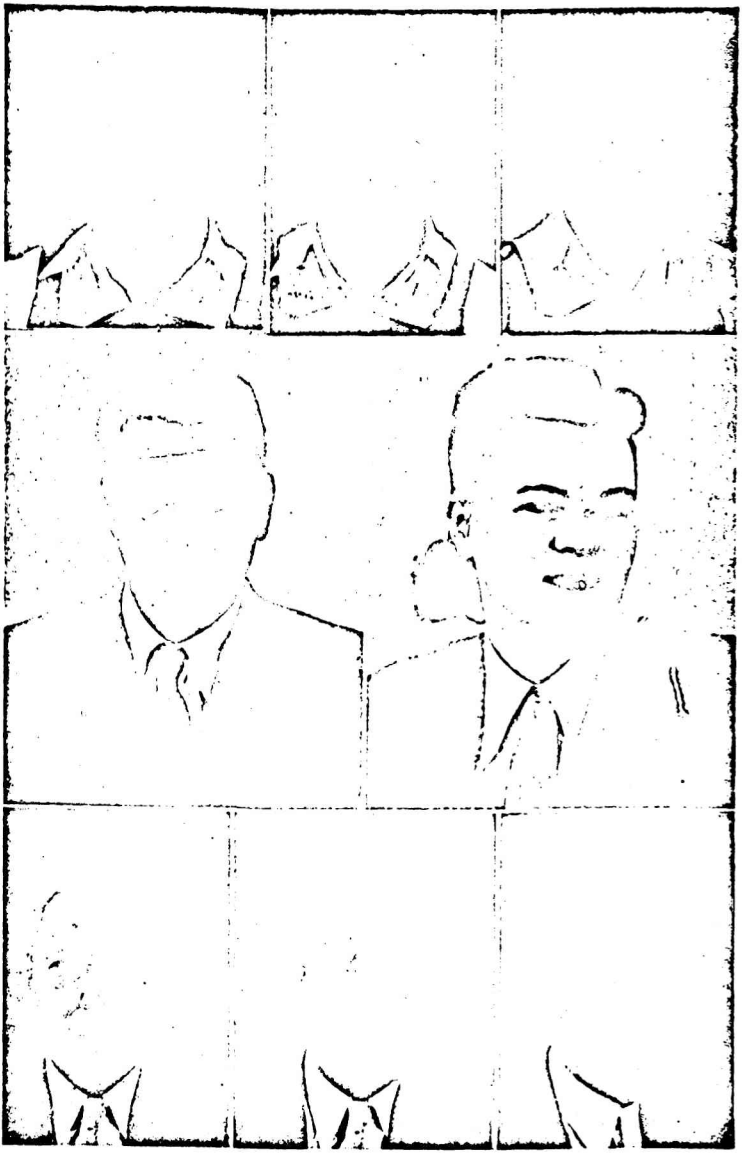

PLATE 2. *Top:* Race No. 3: Alpine (After Coon, 1939, Plate 11, Fig. 1).
Middle left: Race No. 4: Northwest European (Courtesy The University Museum, Philadelphia)
Middle right: Northwest European Prototype, a "Palaeolithic survival." (Courtesy Miss A. J. Stout, Amsterdam, Holland)
Bottom: Race No. 5: Northeast European (After Coon, 1939, Plate 31, Fig. 1)

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beard and body, and usually brunet white pigmentation. This type assumes the status of a population in many parts of its area of characterization, and as such may be called a race.

4. **Northwest European**—Most of Scandinavia, much of the British Isles, Northern France, the Benelux countries, and northwest Germany is inhabited by a population characterized by medium to tall stature, medium build, brown hair, mixed or blue eyes, light skin, straight to wavy hair of moderate abundance, and facial features intermediate between the fine chiselling of the Nordic or Mediterranean and the broader, fleshier Alpine (Plate 2). As types in this population one finds Nordics, Mediterraneans, and stocky, large-headed, broad-faced, often hairy individuals who may have such paleanthropic characters as large teeth and heavy brow ridges. This third type apparently recapitulates in some degree the pre-agricultural population of this region. Western Irish, Scots, Norwegians from the central coast, Swedes from near Goteberg, and certain other local groups deviate strongly in the direction of this type.

The northwest European race is also found as the characteristic form of the major breeding unit in the United States and Canada, New Zealand, Australia, and white South Africa. The white American mean falls so close to it that no further designation is needed.

5. **Northeast European**—From the Baltic to Siberia, Carpathians and Black Sea to the arctic Tundra. The principal breeding units of this vast region are thickset to medium in build, brown- to blond-haired, gray- or mixed-eyed, with moderate beard and body hair development, broad-faced, with long upper lips and snub noses (Plate 2). Teeth are often large. Individual types found in this population include Nordic, Alpine, and variants of Mongoloid.

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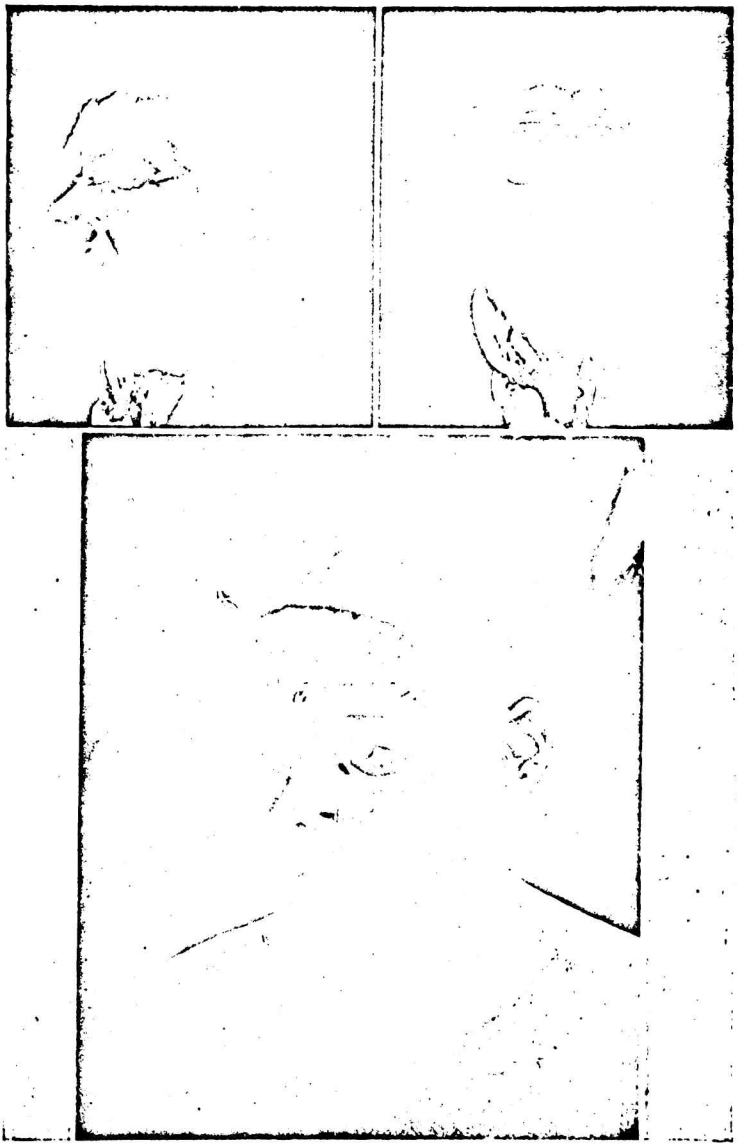

PLATE 3. *Upper:* Race No. 6: Lapp (After Coon, 1939, Plate 1, Fig. 6)
Lower: Race No. 7: Forest Negro (Courtesy Peabody Museum, Harvard University)

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6. **Lapp**—A small, specialized population of reindeer herders and fishermen (Plate 3); short stature, short arms and legs, small hands and feet, brunet white pigmentation, with a minority showing blondism, broad faces, snub noses, widely separated eyes, fragile jaws, pointed chins, and small teeth.

7. **Forest Negro**—The Negro population of the West African forests and much of the Congo (Plate 3). Heavily pigmented skins and deep eye pigment, spiral hair, stocky to medium build with particularly long and powerful arms and large hands, large feet, thick skulls, large teeth, prognathous jaws, and enlarged tissues surrounding bodily apertures producing a thickening of lips, prominence of nipples, etc. Usually considered the Negro prototype. Individuals in this population who have smaller jaws and teeth and narrower noses, and thus look more "European" may reflect local evolutionary change in some cases, rather than hypothetical White admixture, as usually explained. As with all populations containing paleanthropic features, the range is great.

8. **Melanesian**—The Oceanic counterpart of #7, in New Guinea and islands southward and eastward to Fiji and New Caledonia (Plate 4). Regionally variable, but usually characterized by medium to skinny build, deeply pigmented skin and eyes, helical hair, thick skulls, and large teeth. Has a higher frequency of heavy brow ridges than the Forest Negro.

9. **Negrito**—Small in size, medium in build, brown to very dark brown in skin color, with spiral hair and prominent buttocks (Plate 5). Negritos inhabit tropical forests in a discontinuous distribution from the Cameroons to the Philippines and New Guinea. Regional Negrito populations vary. Those in the Congo have abundant body hair and a high frequency of prominent brow ridges; the

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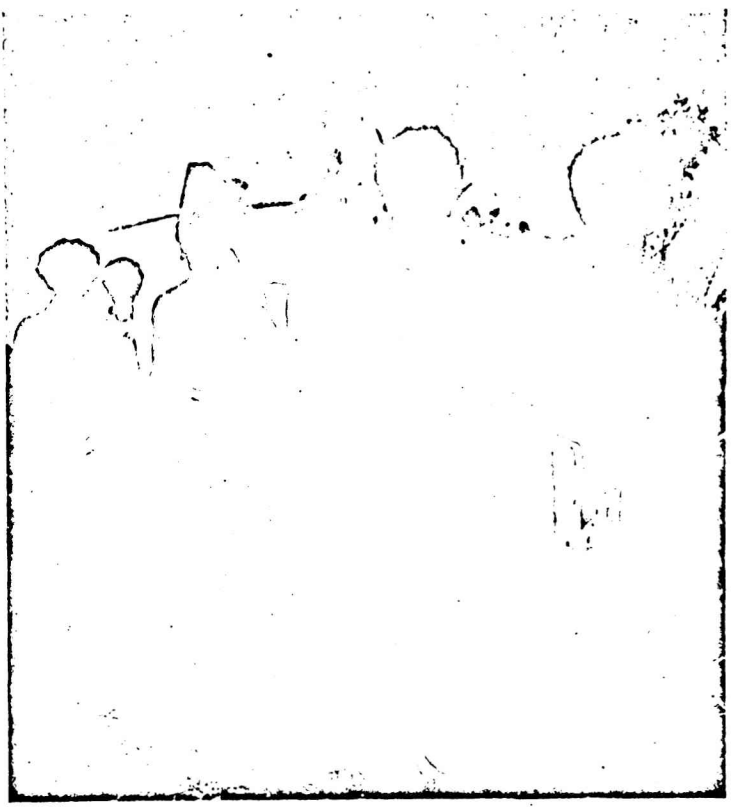

PLATE 4. Race No. 8: Melanesian (New Guinea) (Courtesy AP)

Andamanese seem to lack these paleanthropic features. The Tasmanians, now extinct except in mixture, were Negritos altered by admixture with a Murrayian element.

10. **Bushman (Boskop)**—The aboriginal inhabitants of South Africa from the Lake region and the southern border of the forest southward, in pre-Bantu and pre-Boer times, were variants of a single race. It included a full-sized branch, the Boskop, now extinct or absorbed

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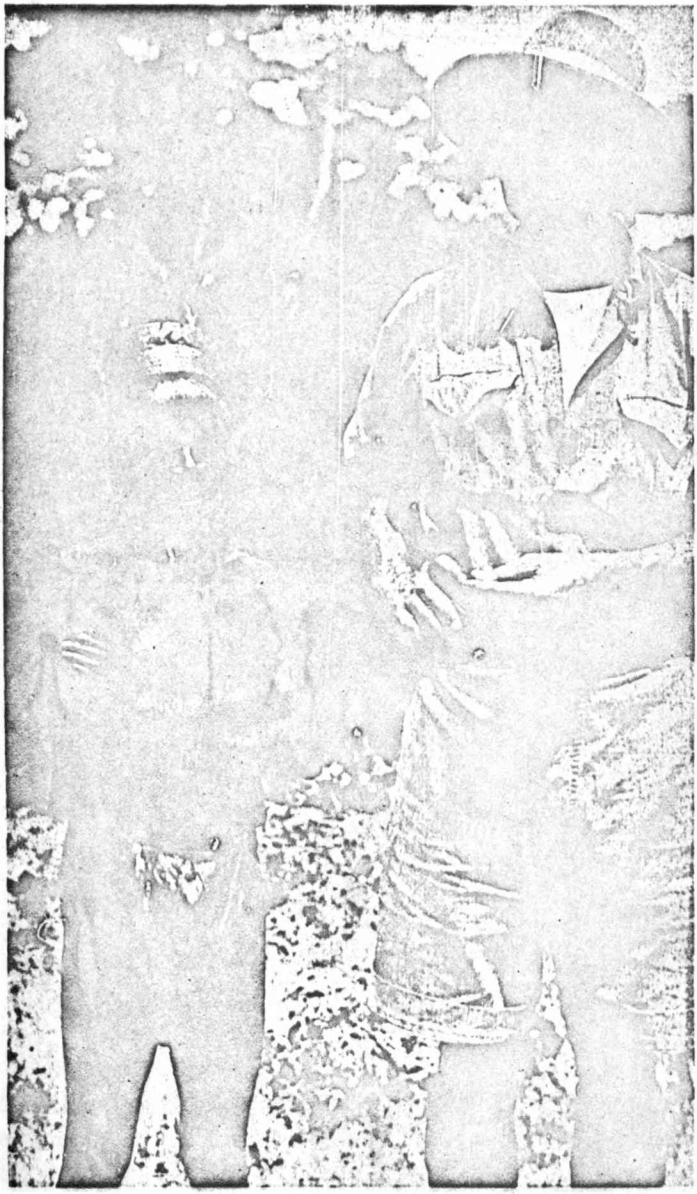

PLATE 5. Race No. 9: Negrito (Congo) (Courtesy The University Museum, Philadelphia)

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PLATE 6. Race No. 10: Bushman. (Courtesy *Life* Magazine)

into Bantu and other groups, and a small-sized branch, the Bushman (Plate 6). The latter is characterized by extreme spiral (peppercorn) hair, yellowish skin, a tendency to steatopygia (fat storage in the buttocks) and certain peculiarities of the genitalia. The build seems to have been

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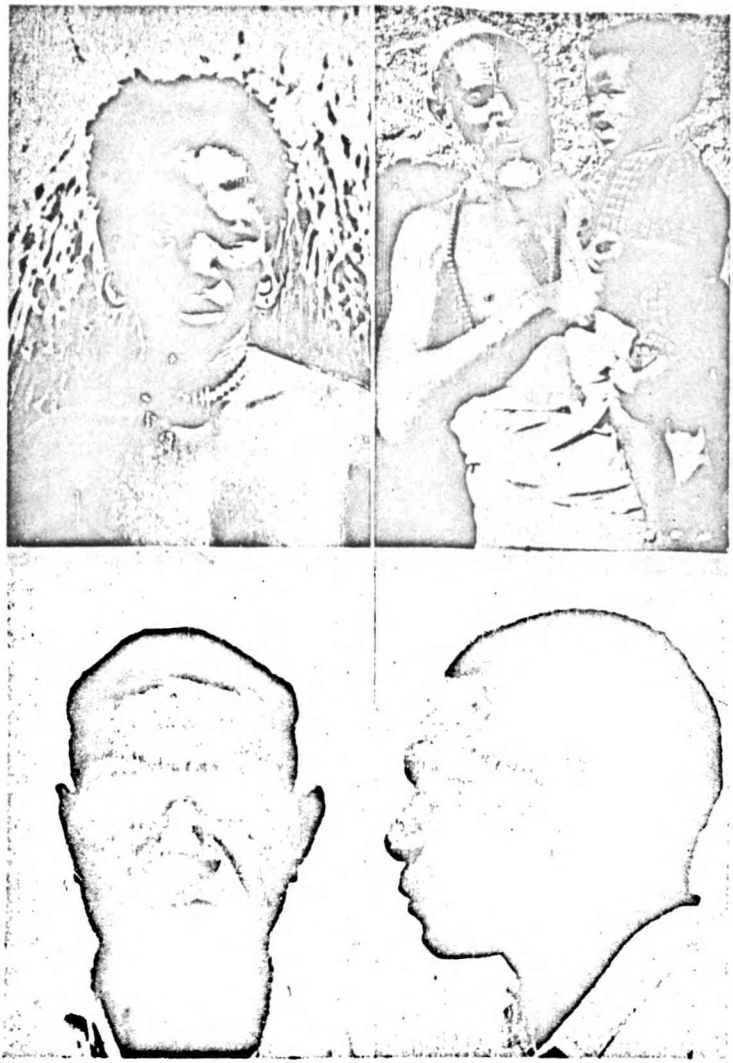

PLATE 7. *Upper left:* Race No. 11: Bantu (Courtesy Peabody Museum, Harvard University)
Upper right: Race No. 12: Sudanese (Courtesy Karakashian Bros., Khartoum)
Lower: Race No. 13: Carpentarian (Courtesy Peabody Museum, Harvard University)

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medium to stocky, in the case of the larger variety, and it is medium to skinny in that of the smaller. Paleanthropic features are less common than with the true Negroes.

A related population, the Hottentot, now also nearly extinct, seems to have been a mixture of Bushman-Boskop with Hamite, to be described later. Although in the minority, the Hamitic element can be recognized in mixture from an inspection of photographs.

11. **Bantu**—A numerous population of recent formation in East and South Africa; a mixture of Forest and Sudanese Negro with the Boskop (Plate 7). The result has a lighter skin color and a stockier build than is found in most of the Negroes living north of the Equator.

12. **Sudanese**—True Negroes closely resembling the Forest type in most respects, but with a skinny build and an extreme degree of skin and eye pigmentation (Plate 7). Probably a lower incidence of paleanthropic characters in most regional populations, with evidence of mixture with Hamites in some.

13. **Carpentarian**—The aborigines of Northern and Central Australia (Plate 7). Skinny build, dark brown skin color, straight or wavy hair, and a high frequency of paleanthropic features, including heavy brow ridges, large teeth, and prognathous jaws.

14. **Dravidian**—Many of the tribes and castes of southern India closely resemble the Carpentarians except for a lower frequency of paleanthropic features (Plate 8). This difference may be accounted for by Hindu mixture, evolutionary change, or both.

15. **Hamite**—Some of the peoples of East Africa and the Sudan seem to be skeletally Mediterranean but dark skinned; they have low to medium frequencies of spiral

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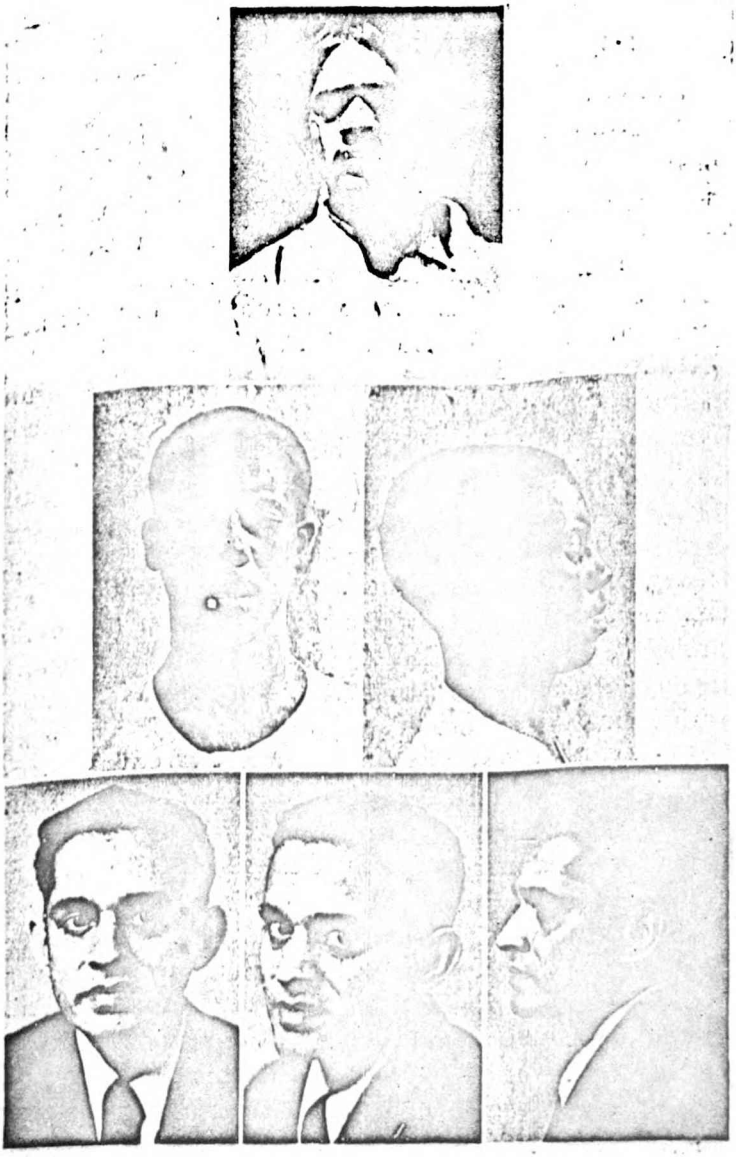

PLATE 8. *Top:* Race No. 14: Dravidian (Courtesy David Mandelbaum)
Middle: Race No. 15: Hamite (Somali) (Courtesy Peabody Museum, Harvard University)
Bottom: Race No. 16: Hindu (Courtesy Dr. A. C. Henriques)

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hair, thick lips, and other Negro features (Plate 8). The body build is extremely skinny.

16. **Hindu**—A light-brown- to dark-skinned Mediterranean, (q.v), usually skinny in build, found as populations in Northern India, and as castes, elements in populations, or types in other parts of the sub-continent (Plate 8).

17. **Mediterranean**—The basic population of the zone reaching from Portugal and Morocco to Northern India (Plate 9); medium to skinny in build, generalized or intermediate in pigmentation, medium to heavy in beard and body hair, with a minority of blond forms, particularly in the iris; medium in head size, with a minimum of paleanthropic features of the skull and face; small faced, prominent nosed, small jawed, often small toothed; with medium to small extremities. Many types may be recognized, but in general the reduction of the face with the consequent projection of the external nose reaches its extreme in the center of the Mediterranean area, in the Middle East, from Palestine to Afghanistan.

The White inhabitants of Argentine and Chile, largely Iberian and Italian in geographical origin, with elements from other parts of Europe, have formed a reasonably homogenous population with general Mediterranean features, but larger in size and heavier boned.

18. **Nordic**—A blond phase of Mediterranean (Plate 9). In no population is blondism complete. In the eastern valleys of Norway and parts of Sweden, where the extreme is reached, probably no more than 50 per cent are wholly blond in skin, hair, and eyes. Nordics are concentrated in Scandinavia, Finland, Northern Germany, the Netherlands, and the British Isles, as well as in areas overseas settled by peoples from these regions. Although it is common as a type, few populations in Europe or elsewhere can be called Nordic in the strict sense. Most which other

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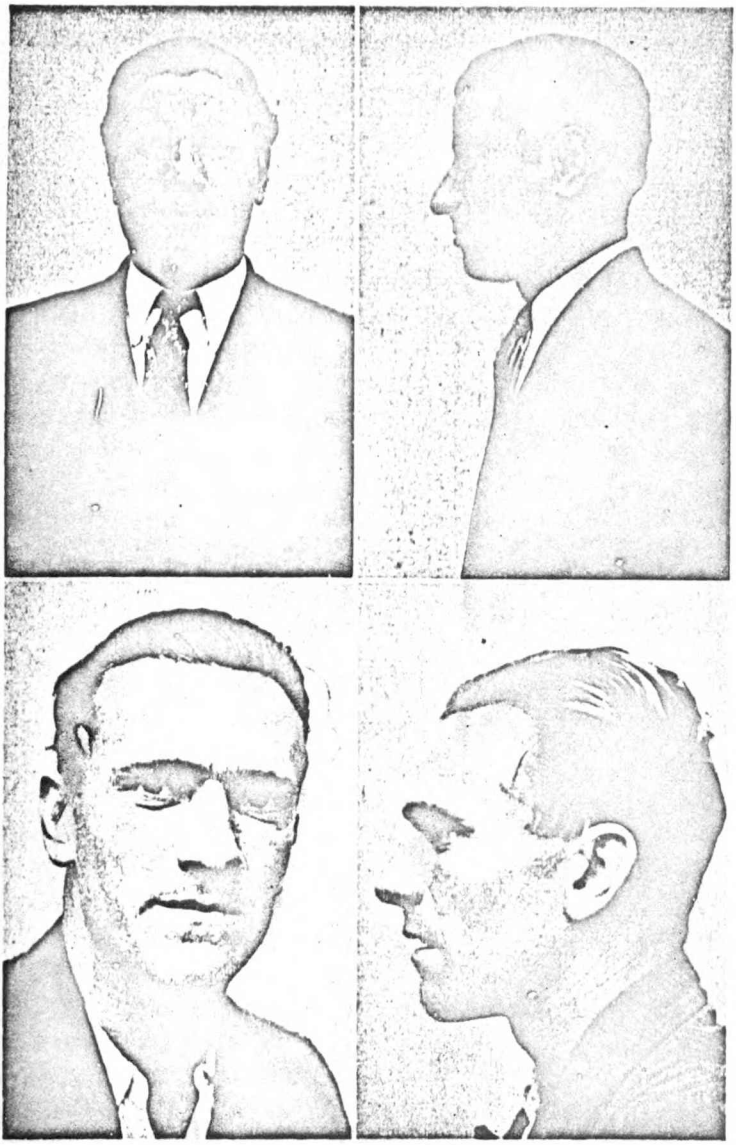

PLATE 9. *Upper:* Race No. 17: Mediterranean (Iran) Courtesy The University Museum, Philadelphia)
Lower: Race No. 18: Nordic

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authors have called Nordic fall into our Northwest European category.

19. **North American Colored**—The "Negro" population of the United States and Canada, differing from the "White" population in pigmentation, frequency of spiral hair, and longer legs in proportion to body height, as well as in some facial features (Plate 10); American Indian is a third genetic element in the mixture. Includes all forms from Forest Negro to the borderline of White, with all possible combinations. For purposes of racial taxonomy it might more reasonably be subdivided into Negro and Mulatto, with the least Negroid extreme included with the Northwest European Whites, into which body many of its numbers have already been assimilated.

20. **South African Colored**—A parallel mixture based on Hottentot, Bantu, White, and other elements (Plate 10). This has never been adequately studied. The "White" element in both this and #19 is far from homogenous, including Mediterranean, Nordic, Northwest European, and others. Part of the variability in both Colored populations may be explained on this basis.

21. **Classic Mongoloid**—Extreme Mongoloid, Buryat-Mongol, and other names apply equally (Plate 11). Stocky build, small extremities, flat face, fat-padded, epicanthus-shielded eyes, coarse, straight hair with sparse growth on face and body; all the features of extreme cold selection. Found in its most concentrated form among Tungusic tribes of the Amur River country, and among the Buryats of the Lake Baikal region. Characteristic of most Siberian aborigines and many Koreans and Japanese, as well as Eskimo. Medium to low in paleanthropic features. Contains a number of recognized types or even populations, as for example the Japanese, which differs mainly in being hairier (most Japanese men can grow mustaches)

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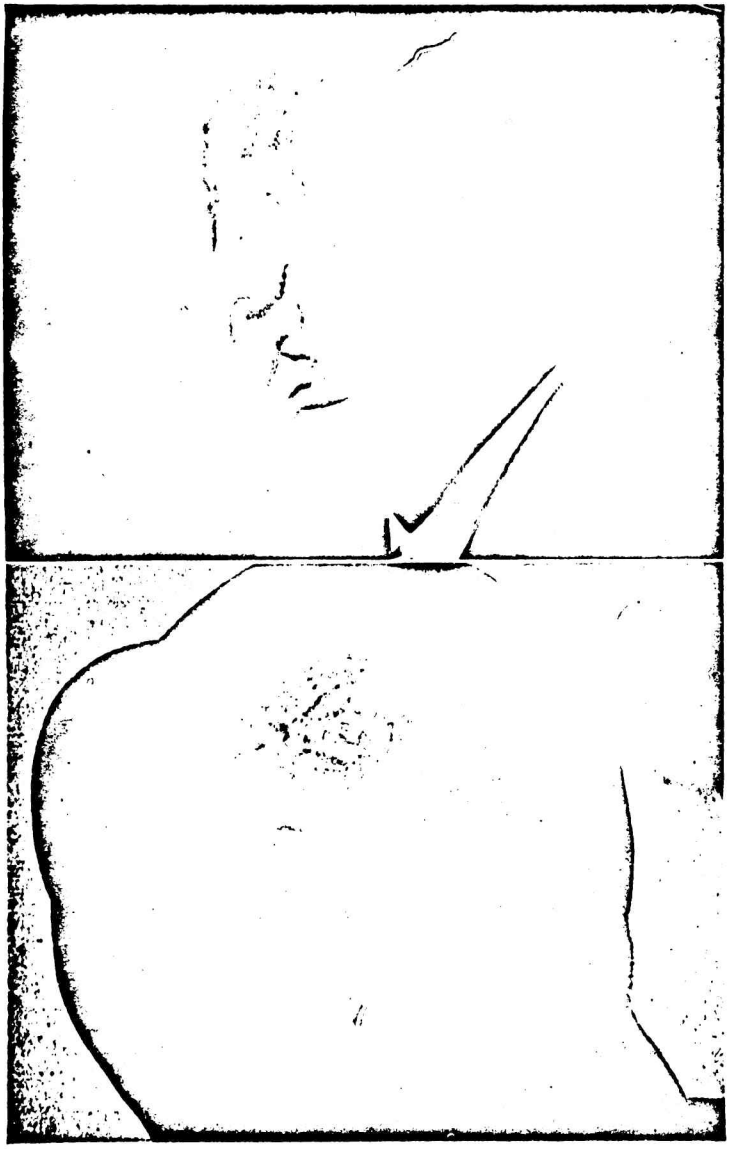

PLATE 10. *Upper:* Race No. 19: North American Colored (Courtesy Roland Hayes and Julian Steele)
Lower: Race No. 20: South African Colored (Courtesy Anne Fisher and *The Geographical Magazine*)

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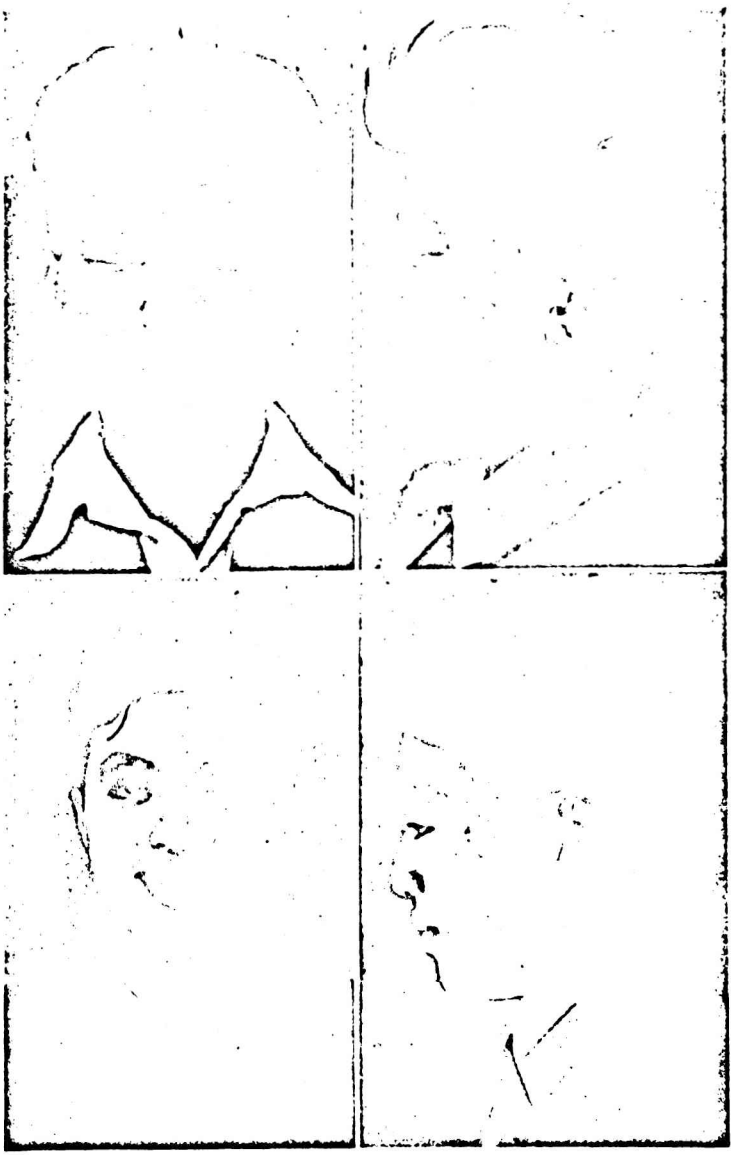

PLATE 11. *Upper:* Race No. 21: Classic Mongoloid (Tungus) (Courtesy Institute of Northern Peoples, Leningrad, and Peabody Museum, Harvard University)
Lower: Race No. 22: Northern Chinese (Courtesy Charles Shade and Peabody Museum, Harvard University)

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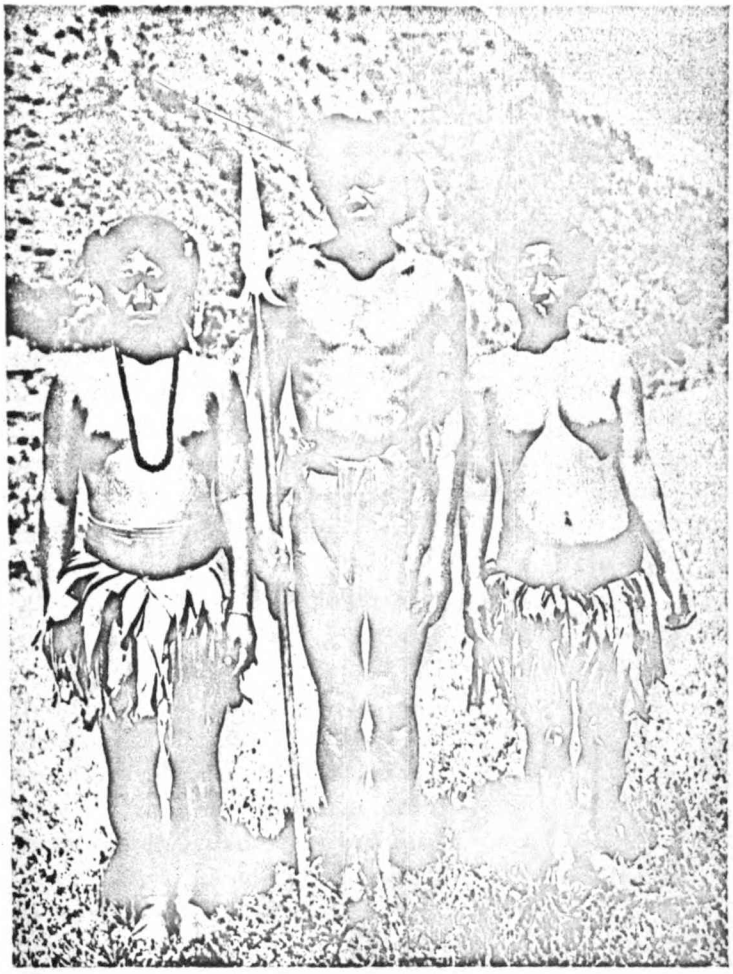

Plate 12. Race No. 23: Southeast Asiatic (Philippines) (Courtesy The University Museum, Philadelphia)

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and in the possession of variant types associated with social strata, as for example a narrow-faced, narrow-nosed aristocratic type.

22. **North Chinese**—A lower frequency of epicanthic eye and other extreme cold-selected features (Plate 11); larger bodies, with many of medium build and some actually skinny; a minority of individuals with non-Mongoloid facial features recalling the Mediterranean. Inadequately studied, although one of the world's two largest populations.

23. **Southeast Asiatic**—Southern Chinese, Siamese, some Burmese, Indonesians of the Greater Sundas, and some Filipino populations (Plate 12). Closer to #21 than the North Chinese in body build and many facial features, although lower than #21 in frequency of Mongoloid eye. Historic and late prehistoric invasions from the North account for the presence of these cold-screened peoples in the tropics.

24. **Tibeto-Indonesian Mongoloid**—The "wild tribes" of the mountains of Sze-Chuan, Eastern Tibet, and Northern Burma, and some of the more marginal peoples of Indonesia, especially of the Lesser Sundas and Northern Luzon, are darker skinned than the other Mongoloids, with more prominent noses and fewer epicanthic eye folds (Plate 13). Found also among the Tibetans proper, as Plate 13 shows. Resembling some tribes of American Indians, they are variously explained as (a) proto-Mongoloids whose ancestors evolved only part way in a Mongoloid direction, or more probably as (b) the result of a mixture between fully evolved Mongoloids and other peoples.

25. **Turkic**—Several millions of pastoralists and oasis farmers of Central Asia present a blend of Mongol and other features, derived from the historic contributions of Mediterraneans, Nordics, and marginal Whites (Plate 13).

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Plate 13. *Upper:* Race No. 24: Tibeto-Indonesian Mongoloid (Tibetan) (Courtesy Sir Philip Neame and *The Geographical Magazine*)
Lower: Race No. 25: Turkic (After Coon, 1939, Plate 3, Fig. 4)

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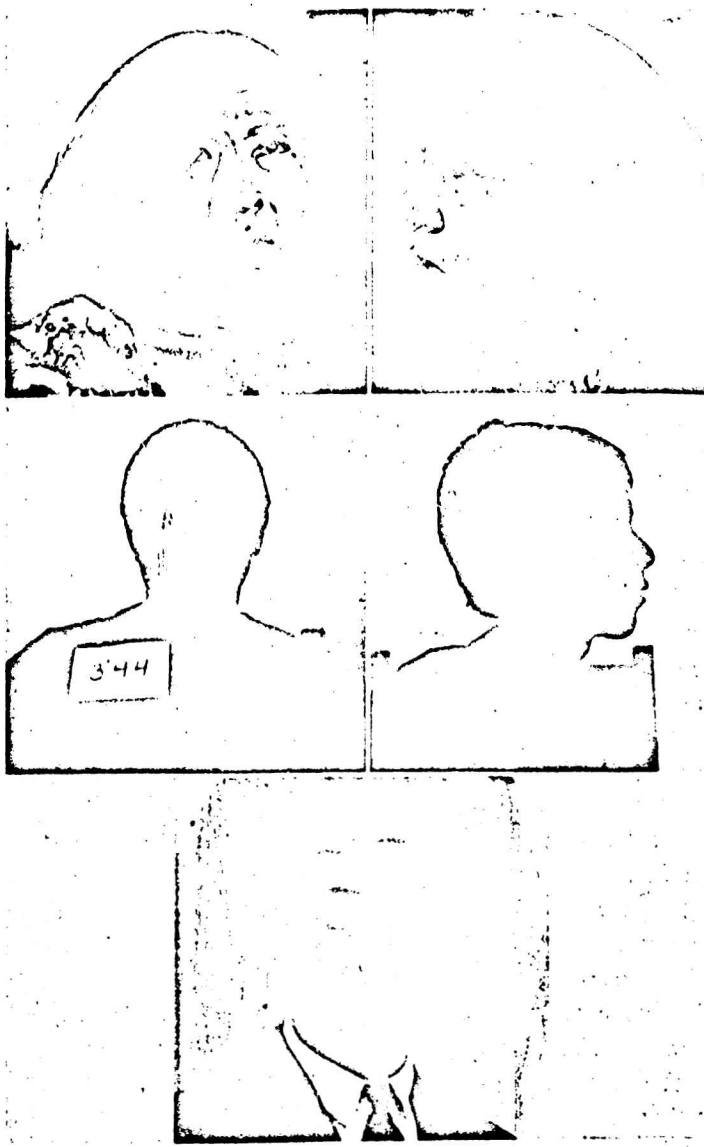

PLATE 14. *Top:* Race No. 26: American Indian Marginal (Ona) (Courtesy Georg Neumann, University of Indiana)
Middle: Race No. 27: American Indian Central (Maya) (Courtesy T. D. Stewart and the U. S. National Museum)
Bottom: Race No. 28: Ladino (Courtesy T. D. Stewart and U. S. National Museum)

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Medium to robust in build, broad-faced, with prominent noses and malars, with coarse hair although often abundant beards, they form a distinctive population.

26. **American Indian, Marginal**—A catch-all for the Indians of North and South America beyond the range of sedentary agriculture (Plate 14). Some, like the Plains Indians, Ona, and Yahgan, are high in paleanthropic features comparable to those shown by Upper Paleolithic Europeans. Others, like coastal Californians, had thick skulls and large teeth. On the whole medium to stocky in build, with varying degrees of Mongoloid features in hair form and distribution and in facial configuration. Much regional differentiation, many distinct populations.

27. **American Indian, Central**—Indians who live by intensive agriculture, from the American Southwest to Bolivia (Plate 14). Smaller in most areas than the Marginal types, smaller boned in general, with big chests in the High Andes, build stocky to medium everywhere, paleanthropic features less in evidence: a New World counterpart of the Mediterranean. Associated with the more complex civilizations of the New World, especially in Mexico, Guatemala, and Ecuador-Peru-Bolivia. Indians of the tropical forest regions do not differ markedly from these specifications, (not yet adequately described).

28. **Ladino**—A population which exists as a caste or class in the same regions as #27, being an old mixture of Mediterranean with the latter, and probably having distinctive features of its own (Plate 14). Back crossing to both parent stocks is probably continuous. In Brazil, particularly in the more equatorial regions, contains African Negro as well as Indian and Mediterranean elements.

29. **Polynesian**—An equally complicated mixture of Mongoloid and archaic White elements, with probable tinctures of Negrito and even Carpentarian (Plate 15);

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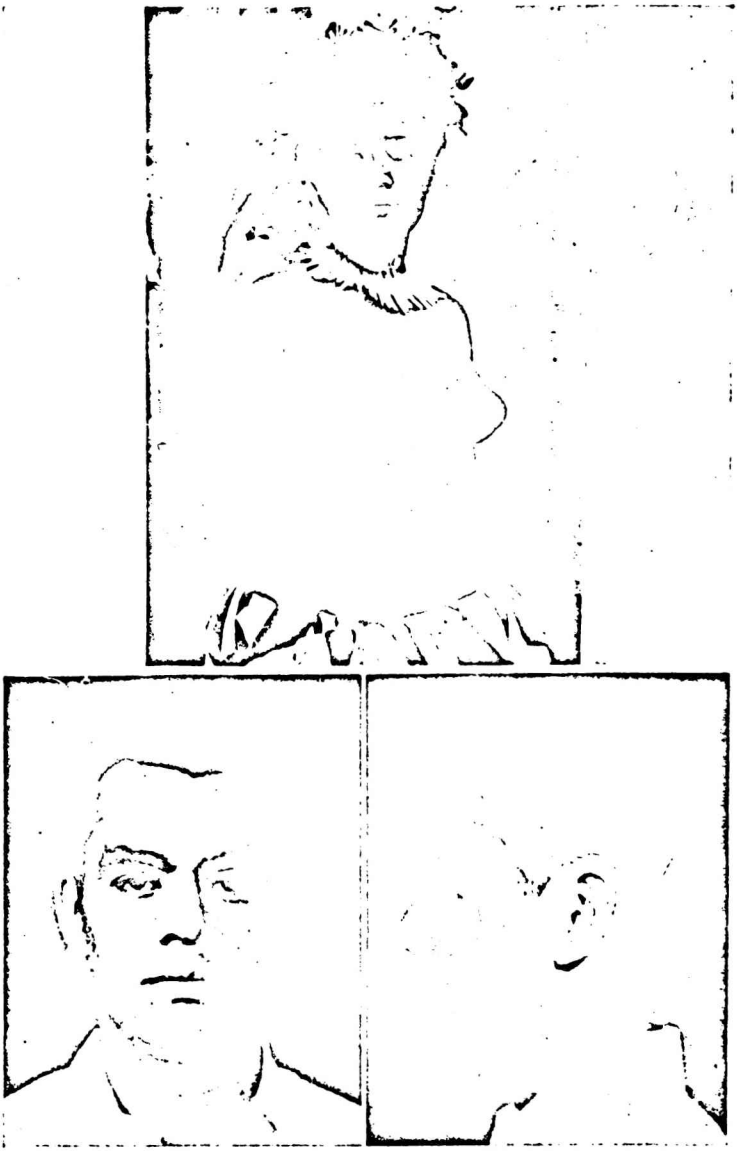

PLATE 15. *Upper:* Race No. 29: Polynesian (Courtesy The University Museum, Philadelphia)
Lower: Race No. 30: Neo-Hawaiian (Courtesy W. W. Krauss)

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this mixture has been stable for about 2,000 years. Body build medium to robust, paleanthropic features present in a minority, skin color light to dark brown, hair straight to helical, varying degrees of Mongoloid facial features. Although some variations exist between island groups the Polynesians have been shown to be basically homogeneous.

30. **Neo-Hawaiian**—A further blend in process of formation and stabilization in the Hawaiian Islands, with various Asiatic Mongoloid, European and American White, and diffuse Negroid elements added to the Polynesian (Plate 15).

The foregoing list of 30 "races" might have been ten or 50; the line of discrimination in many cases is arbitrary. In some cases we have nearly adequate data on which to base descriptions, in otliers almost none at all. In some we know the history of the processes of mixture, interbreeding, isolation, and selection involved; in others we have nothing but the living on which to base our deductions. Mixture is a relative thing, and much of its evaluation depends on our knowledge. If this list does nothing else, we hope that it will bring home to the student the realization that race is not a static thing at all, but that new races are constantly being formed through the mechanisms described earlier in this *Lecture*, and that a new race such as the "Neo-Hawaiian" (#30) is just as *real* as an old one such as the Mediterranean (#17) or the Negrito (#9). History, in the biological as well as the cultural sense, is always in motion.

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CARLTON S. COON, PH.D., STANLEY M. GARN, PH.D., and JOSEPH B. BIRDSELL, PH.D.

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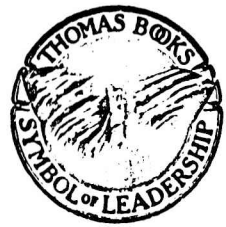

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